Engineering News-Record

A Consolidation of Engineering News and Engineering Record
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IT has been our practice annually to put on this cover a word of Christmas greeting. This year our heart is heavy. Our thoughts, like those of every reader, go overseas—to the boys who are fighting for us, that we and our children may live free lives, that liberty may not perish from the face of the earth.

THEREFORE, our Christmas greetings, full and sincere, with all the tenderness that this season inspires, go forth with anxious thoughts for those "over there." With them go earnest prayers that a lasting peace—that can come only with victory—may soon be with us, and that meanwhile we may be worthy of the men who are fighting for us and to the fullness of our ability, no matter what the sacrifices, may discharge our responsibility to them.

OUR GREETINGS go to them—the boys in khaki and in blue; our hopes, as well as our greetings, to those at home—that valiantly and efficiently we may back up the battle lines of liberty.

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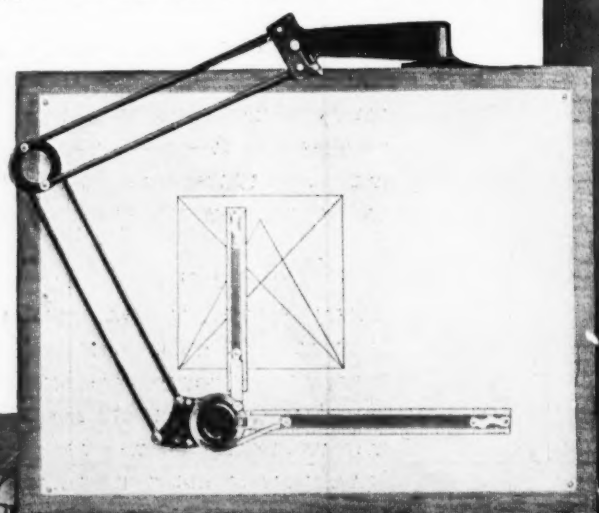

The accompanying view of Stone & Webster, drafting room, shows some of the full equipment of Universal Drafting Machines used by this company.

UNIVERSAL DRAFTING MACHINE COMPANY
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A WEEKLY JOURNAL
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AND CONTRACTING

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Short Stretches vs. Through Routes

A RECENT announcement by the Quartermaster General runs to the effect that the decision to send the 30,000 war trucks from Detroit to the Atlantic seaboard under their own power will release some 15,000 freight cars in addition to moving 90,000 tons of war material. There is no doubt but that even the best route available will result in a staggering cost per ton-mile, but since we provided ourselves with a transportation system adequate only to the slack years, we must pay heavily in times of stress. The weight of this may be lightened somewhat by intelligent use of road funds, particularly by a concentration of effort on those short stretches between industrial centers which, by making the trucks commercially possible, can relieve the railroads of the burden of uneconomical and time-wasting short haul.

Chicago Flat-Slab Ruling Result of Experience

WHEN applied to the concrete flat slab, the easily used phrase "standard method of design" signifies little. The taste and fancy of the designer or the building code maker has a wide range of choice whether he attempt his own theory or accept theories already formulated by other authorities. The latest revision of the well-known Chicago ruling, printed on p. 1153, is therefore only one more of the many methods of figuring the girderless floor. It has, however, more standing than most of the other methods because it is the result of four years of actual experience in designing, testing and using flat-slab buildings in a district where there are probably more of this type of structure proportionate to all building than anywhere else in the country. The revised ruling is not radically different from the old, except in certain additions or extensions of field, which would indicate a superiority due to stability in the method. It has not been seriously affected by the differing coefficients adopted by society committees since the original formulation of the Chicago ruling.

Commercial Foresight

QUITE properly our thoughts now are almost wholly occupied with war—with the way in which we can contribute toward its winning. All absorbing as the conflict is, however, some thought must be given—secondarily, of course—to the conditions that will obtain after the armies have disbanded. While we were still spectators of the war there was much discussion of these post-bellum conditions by every class of men. The problem is still important. It has merely become overshadowed with a more tremendous issue. That the commercial interests of the country intend to be prepared for the new order, so far as foreign trade is concerned, is apparent from the advertising pages of this journal. In a recent issue were no less than four great export organizations presenting the advantages of their service in handling oversea trade. Two years ago the manufacturers in fields allied to civil engineering and contracting gave relatively little thought to the export business. Now they see that with tremendously increased productive capacity, a large merchant marine and the great resources of the United States the stage will be set for our participation in the great drama of international trade development. This commercial expansion is important for the engineer and the contractor, because American machinery cannot go to foreign countries without American genius to operate it. There are three factors—the engineer, the builder of machinery, the contractor—and no one of them can be omitted if the work is to be rewarded with a full measure of success.

Army Engineer School a Necessity

AN ENLARGED army enginering school, such as recommended by Secretary Baker in his annual report, would seem to be one of the necessary improvements forced on us by the war. West Point has not been an engineering school for many years—not since the ideals of technical education passed beyond the fundamentals of science. With the admirable basis of general knowledge and mind training gained at the Military Academy, the star graduates became engineers only after an intensive course in an inadequately financed Engineering School at Washington, and subsequent instruction in practical engineering under a higher officer on station. This served in our peaceful days and under our small army, now gone. For many years to come military engineering will probably be a science demanding the thorough and lengthy application of its students and the best of facilities for its instruction. It is to be hoped that in the crushing demand for immediate military force, Congress will not so far forget the early future as to pass over the Secretary's recommendation.

Records of Engineering Thought

WHAT we must absorb and take with us from each great engineering work is perception of the builder's creative thought. Without that creative element the work could not have been great; it would be only routine development of the existing art, refined perhaps by ingenious analysis or design, but yet the mere routine of skill—good craftsmanship, nothing more. And every great work of enginering is something more than this: it is the expression and outgrowth of creative imagination.

But the masters of engineering have been remiss, strangely remiss, in recording for the benefit of their fellows and posterity how they wrought their great works. Structural engineers in particular have failed to leave such records. The art is written in its structures, about as the building art of Egypt is written in the pyramids and obelisks it erected. This is unfortunate, for the sake of future development as well as for the sake of history.

Bridge-builders lack vision, one engineer has said. But that cannot always have been true, in view of the brilliantly original creation manifest in many a historic structure. Nor, do we believe, is it altogether true today. In the last few years alone we can find many a work of boldest precedent-disdaining originality, in the field of bridges. We see represented therein not merely courage, or free fancy, or the mathematician's insight, but a composite which blends all three of these together with solid structural appreciation of strength; and it is this mental composite, clearly, that was the creative faculty.

Just in so far as such facts can be read out of the finished structure—after patient study and comparison with what went before—to that degree can we draw inspiration from the engineer's completed work. We need more, to make the gain reasonably sure. We need a record of the thought processes by which the engineer arrived at his result, if it is possible to get such a record.

An attempt is made, on page 1140, to give an account of how the immense Metropolis Bridge span was planned —one of the five or six boldest structures of the past half dozen years. The account is hardly more than a series of random notes, lacking the story of the chief engineer, who lost his life on the work. But it may help some engineers, and especially some of the younger men, to a better appreciation of the structure.

Two facts about bridge-building come into mind in this connection. One is that few of our notable bridges three or four decades old are well known to the engineers of today; and what is known about them hardly exceeds the limits of descriptive data. How much the builder of a particular bridge advanced the art of his day has long been forgotten. Through lack of a record we have lost much of the possible benefit of his engineering thought. The other fact is that for twenty years or so the art of bridge design has remained nearly stationary, in its larger features at least. With individual exceptions, progress has been in detail, not in broad conception. To say that these two facts are closely related may be unwarranted; but who will assert that they do not have contact somewhere?

The preceding lines, and the Metropolis account, constitute a plea for better recording, in future, of the originating thought embodied in engineering works. Bridges are only one field—and a typical one—to which the plea addresses itself.

Engineering Society Service and Organization

THERE were two particularly significant notes struck in the addresses attendant upon welcoming the American Society of Civil Engineers to the Engineering Societies' Building—Mr. Saunders' plea for an organization of the profession along the lines of our political system, by states, counties, cities and wards, and Professor Swain's advocacy of more service by the societies to the individual members.

Neither suggestion is new. Mr. Saunders has heretofore advocated the organization of an engineering civic federation, and desisted from its advocacy only because there was proposed shortly thereafter the Engineering Council. In a measure some of the elements of Mr. Saunders' plan have long been recognized—in the encouragement given and the place accorded the local engineering societies by progressive students of the engineering society problem. The impossibility of bringing the influence of a national society to bear on a local problem is self-evident. The local organization, however, not being tied down by the necessity of considering points of view dependent upon difference in locality, has a freer hand.

There is question, too, whether the national societies, organized primarily for technical and scientific work, can even on national questions work effectively in so different a field. The question does not deny the need for participation in civic affairs, but asks merely as to the agency through which that participation shall be exercised. There are signs that those in high places in the national societies appreciate keenly this difficulty, for it has been proposed that the Engineering Council, in which the civic activities shall center, will eventually represent not merely the four national engineering societies, but other engineering organizations as well.

Professor Swain's proposal that the societies should do more for the individual members likewise is not new. He has emphasized it repeatedly. The reiteration of it at such an auspicious meeting, however, was significant and well advised. Moreover, the comments on his proposal following the meeting indicated clearly that he had struck a sympathetic note.

It will be remembered that the American Association of Engineers, founded at Chicago some years ago, is based upon that idea—that the first duty of an engineering society is to serve its individual members. That idea was scoffed at. The association was condemned as a movement for the unionization of the profession. Yet the body has grown in strength and has won the support of influential men. Now we find the idea broached at one of the most auspicious meetings the profession has ever known and making such an impression that it is reflected in the corridor talk.

Mr. Saunders and Prof. Swain have in an emphatic way called upon all engineers to give thoughtful consideration to these two important proposals. While there will be much discussion of Mr. Saunders' plan—possi-

bly disagreement—there can be no doubt whatsoever that in Prof. Swain's suggestion will be found an avenue for making the engineering societies of the country a still more vital part of the profession than they have been in the past.

How Shall the War Highways Be Determined?

LAST week the Office of Public Roads endorsed, in effect, the plans for making a highway war program worked out by the American Association of State Highway Officials at Richmond, Va. The office asked state highway departments to express their views on the following program:

1. Selective consideration of next year's work with a listing of each job in the order of its economic importance to the territory in which it is located and to the nation as a whole.

2. Coördination of highways with railway and water transportation facilities with a view to insuring a sufficient number of cars and vessels for the transportation of road materials.

3. Coördination with the materials industries to insure supplies of materials adequate in amount, distribution and deliveries, so that the program determined on may be carried out.

There is no difference between this plan and that adopted at Richmond. However, the state highway officials asked that actual data coming under these heads be cleared through their executive committee while the Office of Public Roads for the present merely invites a discussion of topics.

It is apparent, therefore, that there is unity of plan as between the Office of Public Roads and the American Association of State Highway Officials. Moreover, since the director of the office is a member of the Highways Transport Committee, it is certain that the latter body, also, is in agreement with the proposed procedure. Thus the three highway agencies determinative in the present crisis are working together.

There being agreement as to procedure, the need now is for a plan by which the state highway departments may determine which roads can relieve railroad congestion or otherwise help the nation in this crisis.

Evidently, the plan must be such that information can be secured quickly. Between now and the date for opening construction—let us say Apr. 1—a tremendous amount of work must be done. The war roads must be determined; authority for cars secured, if necessary, and contracts let. In many cases, financial arrangements—the sale of bonds, or the allotment of funds—must be made. Of course, each highway department now has certain information regarding the importance and traffic of some routes. But conditions have changed materially in a few months. Moreover, routes now little used because of this condition may be the very ones that could be made most useful. In any event, exact data will win when and if it becomes necessary to put these plans before the authorities at Washington; and to that end the strongest possible presentation should be prepared.

Evidently, if the information is to be secured at maximum speed, it is necessary to call upon those who are constantly dealing with transportation matters and who, therefore, are informed regarding the relative congestion and importance of various routes. Manifestly, these are the traffic managers of the various industries and the railroads themselves. Before the war it would have been futile to ask the railroads to supply such information. Now, they eagerly welcome any agency which can help them out of their difficulties.

To secure the help of the traffic managers of the industries, the chambers of commerce, boards of trade, and manufacturers' associations throughout the country can be of tremendous assistance. They are organized for work among the manufacturers of their respective communities and can at once secure immediate attention and action. They have the organization machinery for just such work. Moreover, they are seeking opportunities to serve the nation. The call of the state highway department would meet with a ready response. A meeting of traffic experts in each sizable community, working through a committee selected by themselves, could in a very short time report back to the state highway departments the routes whose maintenance or improvements can in that particular district be of greatest service in relieving transportation difficulties. We know of no other agency which can mobilize for action so quickly.

More effective action from these bodies, of course, will be secured if the state highway departments themselves present clearly, as a basis for the activities of the traffic experts, some fundamental ideas regarding highway and motor-truck traffic. Fortunately these were well brought out at the Richmond convention and are pretty distinct in the minds of the heads of each state highway department. Obviously, the highway is of best service for relatively short hauls—60 to 80 miles. It is most economical when the trucks are loaded in both directions. Here again the interest of chambers of commerce and manufacturers' associations will be of very great value, because they are in a position to establish such committees or bureaus as will insure loaded traffic both ways. What that traffic will be will depend, of course, on local conditions. In one case finished products will be carried out, and raw materials in. In other cases, industrial traffic in one direction will be supplemented by foodstuffs in another.

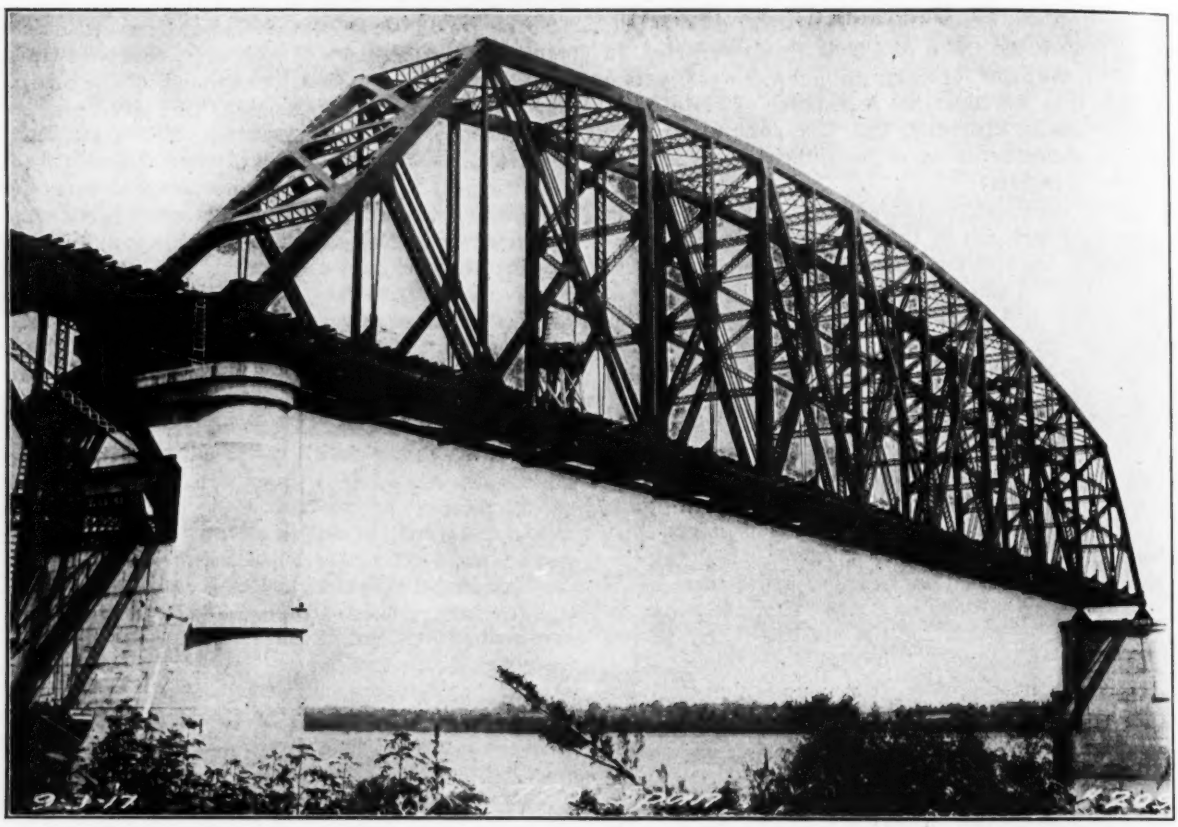
In any event, the initiative and brains that will be brought together by the commercial associations in mobilizing the traffic information in their respective centers will not only produce the information needed to map out a highway war program for the district, but will result as well in ideas for conducting highway transport with the greatest economy.

We, therefore, commend to the consideration of the various state highway departments the plan of calling upon the dominant commercial bodies in the cities of their respective states for assistance in gathering the data for the highway war plan. That they will receive a prompt and effective response is certain.

As regards the very important matter of maintenance it may be noted that the state highway departments may obtain assistance from the state councils of defense, which have been asked to look after the maintenance of routes to the seaboard and to keep the Lincoln highway open.

Designing the 720-Foot Metropolis Span

Simple-Span Type and Special Steel in View from Start—Maximum Use of Eyebars—Silicon Steel—Detailing To Save Weight



THE 720-FOOT SPAN OF THE METROPOLIS BRIDGE LOOKS LIGHT BECAUSE THE TRUSSES ARE MADE OF HIGH-STRENGTH STEEL

THE 720-ft. main span of the new Ohio River bridge at Metropolis, Ill., the world's largest simple-truss span by a margin of 52 ft., constituted an engineering problem of the first magnitude. Eight years' planning formed the background for the final design. Study of the determining ideas in design is important in the present-day state of the bridge constructor's art, but in this case it was rendered difficult by the untimely death of C. H. Cartlidge, bridge engineer of the Chicago, Burlington & Quincy R.R. and chief engineer of the Paducah & Illinois R.R., the company building the Ohio River connection between the Burlington and the Nashville, Chattanooga & St. Louis R.R. However, it proved possible to make such study from the records of the railway, supplemented by information obtained from A. Engh, assistant bridge engineer of the Burlington, who was connected with the Metropolis work throughout the final design, and Ralph Modjeski, consulting engineer, who advised and approved the design.

General drawings of the bridge and many details of the large span were given in *Engineering Record* of July 10, 1915, and Dec. 23, 1916, and in *Engineering News* of July 28, 1915, and Dec. 21, 1916.

The length of channel span was determined by the U. S. War Department's requirement for a 700-ft. channel width. For such a length the cantilever type of bridge has heretofore been regarded as standard. The Burlington's engineers, however, believed that there were favorable possibilities in a simple-truss span, provided steel of higher strength than ordinary 60,000-lb. bridge steel were used.

It has been believed by some that a simple span of this length would be virtually impossible to build of 60,000-lb. steel. This is not the case, though the difficulties of design would have been very seriously increased, especially as to sizes of members and joint-packing. The fact remains that special steel was contemplated from the first, on the ground that in this range of magnitude of span it secures economy of total cost by reducing the dead weight to be carried.

Several of the engineers advised a cantilever span. Comparison of a simple span with a cantilever design was made, and the latter showed materially lower cost, despite the reduced opportunity for using eyebars. The advantage of safety in erection, by dispensing with falsework, weighed even more heavily in favor of the

cantilever. Experienced bridge erectors say that erecting so large a span on falsework in the uncertain flow conditions of the Ohio is inevitably hazardous. The contractors for the bridge were distinctly relieved when, after remarkably rapid and smooth erection, they closed and swung the big span (last December) without high-water troubles.

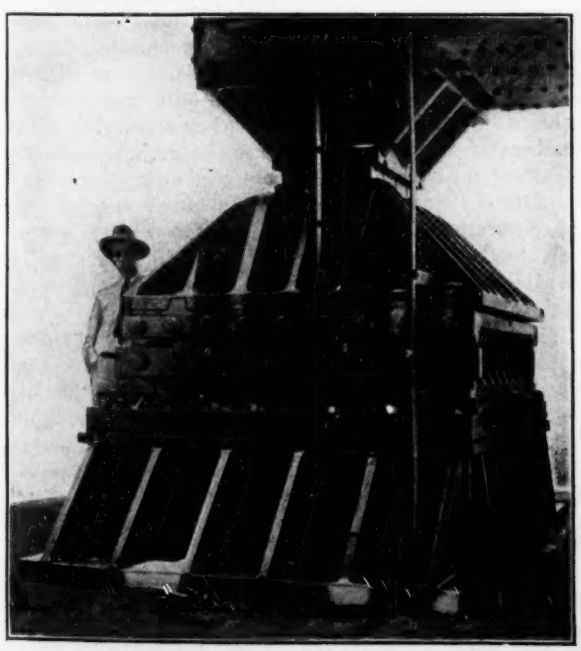
Mr. Cartlidge favored the simple-span type strongly. The main consideration was rigidity, but belief in the greater wear-resistance of the simple type may have been an additional factor. The pier caissons of the bridge rest on sand, and there is some reason for thinking that rock foundations would have led to more favor for the cantilever; that possible settlement of the piers was thought likely to derange a cantilever structure more than a simple-span bridge.

Full pin-connected construction was also early decided upon. Large joint connections were thus eliminated and the use of eyebars provided for. Through these features much weight was saved; and in the Metropolis span weight-saving was so vitally important that it dominated the detail design, when once the general elements had been fixed.

With respect to eyebars, all the engineers favored extensive use of eyebars in the span. The superior strength and reliability of the eyebar over other forms of tension member is a decisive advantage, supplemented by great saving of weight in dead metal. The disadvantages of eyebars disappear in a span of this size. Mr. Cartlidge carried the preference for eyebars to unusual limits, however, as noted farther on.

After deciding for a simple span, selection of truss type lay between two, the subdivided Pratt truss and the K-truss, both with curved top-chord. The engineers believed the former preferable, but a K-truss design was carried far enough to prove the Pratt truss more advantageous, and therefore the latter was adopted.

The choice of material lay at first between high-carbon steel, Mayari steel and nickel steel. Later a special steel was offered under the name "silicon steel," a carbon steel with its silicon, carbon and manganese raised well above ordinary bridge practice. Comparison among these materials involved both cost estimates and strength tests. A set of large-size column tests was made by the Bureau of Standards for the purpose, abstracts of which were published two or three years ago. Allowable unit-stresses were determined on the basis of these tests.



THE SIZE OF THIS EXPANSION-END SHOE GIVES SCALE TO THE VIEW OF THE COMPLETE SPAN

Silicon steel received the final preference. A comparison with a design using high-carbon steel in top chord and end posts (and ordinary steel elsewhere) showed the latter design to be considerably heavier. The competition of silicon with Mayari and nickel steels seems to have been decided by price.

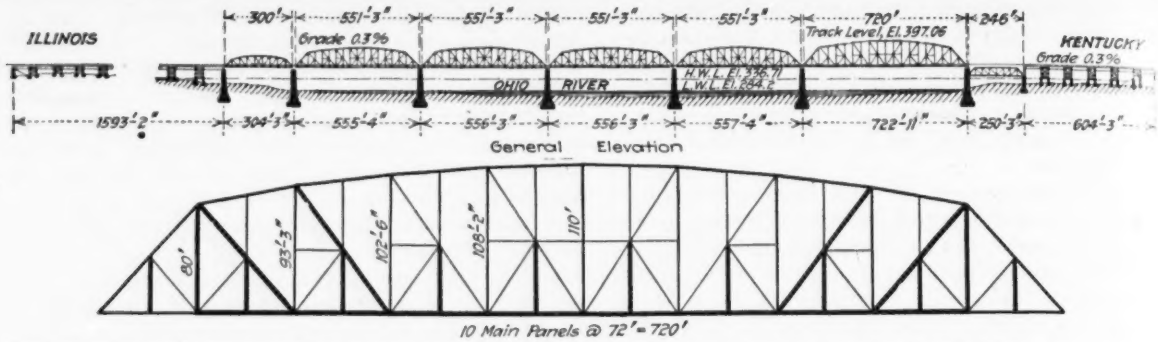
The adopted material was at first proposed for the compression members of the trusses only. Eyebars of silicon steel were not offered by the makers; instead, nickel-steel eyebars were proposed and used. For the riveted tension members in the end panels of the bottom chord and the diagonals of the four middle panels (where reversing members were adopted instead of using counters) it was planned to use plain carbon steel. The engineers did not trust the tensile reliability of silicon steel in a riveted member. But their convictions on this point changed later, when it became apparent that the material could be worked without injury (in a certain range of thickness). Consequently, the members in question were made of silicon steel, but subjected to lower unit-stresses than the nickel-steel eyebars.

The selected materials made it possible to use a basal unit-stress of 25,000 lb. per sq.in. in tension and 30,000 in compression for the built members of the trusses, and 35,000 in tension for eyebars. As compared with a 20,000-lb. unit-stress, this increase of 20% and over decreased the total steel weight of the span by more than 30%, even with ordinary bridge steel in the floor.

Experience in the shop demonstrated that silicon steel could be punched in thicknesses up to ¾ in. with no greater effect than in ordinary bridge steel. The early beliefs of both makers and engineers had, however, been opposed to the practice of punching silicon steel, and for this reason throughout the job the holes were drilled from the solid.

For the floor system it was at no time contemplated to use anything but plain bridge steel. The best expression of the reason for this is that, with the uncertainties of a new material opposed to the recognized punishing qualities of carbon steel, it was believed that the latter could not be dispensed with. Additional factors were the desire to have thick metal in the floor members and the striving for maximum rigidity.

Opinions have changed somewhat since the Metropolis bridge was designed, and two bridges are now under way which use silicon steel in the floor as well as in the trusses. In both cases the floor is double-track, just as at Metropolis. Calculations have shown that with long panels and double track the cost of a floor of silicon steel is no greater than the cost of a carbon-steel floor, and the influence of the reduced floor weight on the trusses of a long-span bridge is therefore a net gain. This has bearing wherever the considerations above



THE RECORD-BREAKING SIMPLE-TRUSS CHANNEL SPAN OF THE METROPOLIS BRIDGE OVER THE OHIO IS OF EXTREME PIN-AND-EYEBAR TYPE. HEAVY LINES IN THE LARGE DIAGRAM INDICATE EYEBARS

quoted as determinative in the Metropolis case are not held to be decisive.

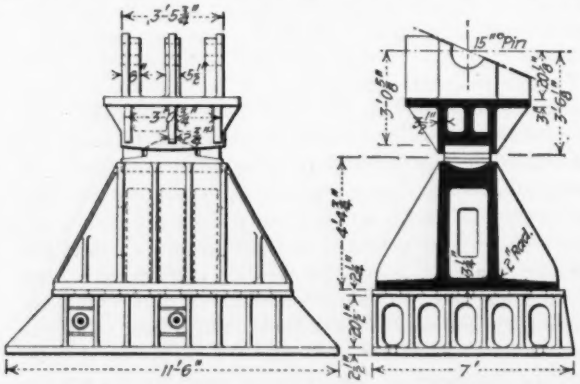
In developing the outlines of the simple span design, the truss depth and the panel-length were studied by comparative estimates.

The calculations of weight for different truss depths led to a decrease of the first-chosen depth (120 ft.) to 110 ft. The panel-length was increased to 36 ft. after comparison with a panel of about 30 ft., the former showing lower weight. None other than a subdivided web-system was in view at any time. The width of bridge (spacing of trusses) was made slightly greater than the traditional specification requirement for width not less than one-twentieth of the span. A spacing of 37 ft. was adopted; earlier, a spacing of 40 ft. had been considered.

To assure long life of bridge, a large future increase of loading was counted on. The train load was assumed at 7500 lb. per foot of track, and the engine driving-axle loads at 90,000 lb. These figures represent a margin of at least 25% over present-day traffic weights. They may be regarded either as regular design loading for normal service stresses or as emergency loading by which to test the design for safety under limiting conditions.

The important problem in the detail designing was to hold down the weight to an absolute minimum.

It was Mr. Cartlidge's strong conviction that all the weight economy obtainable by the use of eyebars as tension members should be obtained. In carrying this into effect, even the sub-hangers, which carry the intermediate floorbeams, were detailed as eyebars. The hip



BRONZE BEARING BLOCKS IN END SHOES FOR ADJUSTMENT DURING ERECTION—STEEL WEDGES PLACED AFTER SPAN WAS SWUNG

vertical is also made an eyebar member, but for erection service it was given some value as a strut by riveting a transverse plate diaphragm longitudinally between the bars.

Most characteristic of the bridge is the use of long (72-ft.) eyebars in the bottom chord. There is no connection between these bars and the floorbeams at the subpanel points, but a simple stirrup at the end of the floorbeam supports the bars, as shown in one of the drawings. By this arrangement, secondary stresses due to distortion of the subpanel triangle under load are eliminated, while at the same time the weight of a pin and two sets of eyebar heads is saved. A similar arrangement was used years ago in the Bellefontaine bridge of the Burlington, designed by George S. Morison.

At various connections in the web system two pins were used, in order to reduce the size of the joint-connections. At the foot of the hip vertical the connection of hanger to floorbeam is made by a 12-in. pin placed 8 ft. 9 in. above the main 14-in. pin at L2.

The economy secured through use of the eyebars is represented by the sum of 10 to 15% saving of section in rivet holes and details and 5 to 10% increase in unit-stress allowable in eyebars over built members. Thus, about 25% of the weight of tension members in the trusses was saved, comparing with built members of nickel steel, and about 35 to 40% when comparing with members of silicon steel. Because the eyebars were so important for economy, they were used even where serious difficulty was encountered in making room for the end connections. Diagonal U4-L6 was a case where the substitution of a built member would have simplified the joint details considerably, but eyebars were retained.

When the erection problem was worked out by the contractor, the eyebars in the web system and the long bottom-chord eyebars were objected to because of the delay resulting from the awkwardness of handling such long, flexible members. But the engineers adhered to their plans, and as already stated the only use of built members in tension is in the diagonals of the four middle panels and the bottom chord in the end main panel.

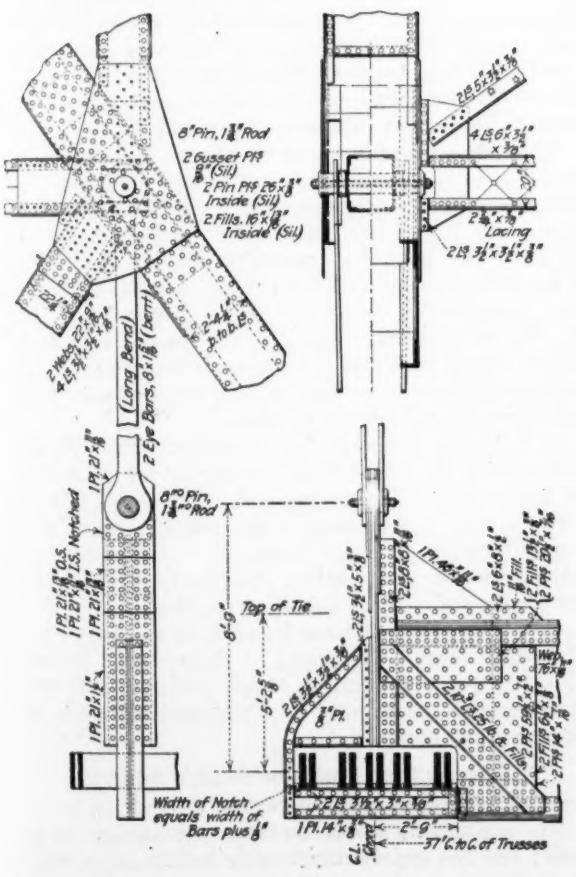
To save weight of lattice and other detail metal in compression members, the top chord and the posts were detailed of H-section, using a central transverse diaphragm. For example, the middle top-chord member consists of two webs 42 x 1¼ in., four angles 8 x 8 x 1⅛

in., four flats 10 x 1 3/16 in., and a diaphragm with web 32 x 3/4 in. and four angles 6 x 6 x 5/8 in. All of this metal is effective cross-section, and while top and bottom lattice is also used it forms a much smaller proportion of weight than would otherwise be needed.

Partly because of the presence of the diaphragm, very thick plates in the side ribs of the top chord were thought permissible—as, the 1¾-in. plates just noted. Some difficulty developed in the shop in securing acceptable plates of these dimensions, especially with regard to straightness, or freedom from waviness at the edges. It is now believed to be better practice to use plates not thicker than 1 in. to 1¼ inches.

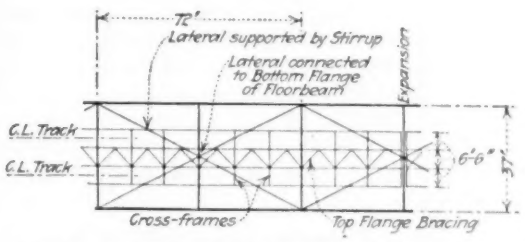
The central diaphragm required special details at the pin joints, as the diaphragm had to be interrupted here. Vertical interior webs carry the stress across the joint.

In the floor occur one or two interesting weight-saving details. There is only one stringer lateral system, placed between the two center stringers; occasional struts in the plane of the upper flange extend over to the outer stringers to brace them. There is no traction bracing. Longitudinal forces pass from the stringers into the subpanel floorbeam and this must transmit them (by bending) to the middle of its length, where the diagonals of the main bottom lateral system are attached to the lower flange. These diagonals clear the lower flanges of the stringers, but are hung from them by stirrups.


8" Pin, 1¾" Rod
2 Gusset Pls 9/16" (Sil)
2 Pin Pls 26" x 3/4" Inside (Sil)
2 Fills. 16" x 3/8" Inside (Sil)
4 L's 6" x 3½" x 7/16"
2 Lacing
2 Web 22" x 3/8"
4 L's 3½" x 3½" x 3/8"
(Long Bend)
(Vert.)
2 Eye Bars, 8 x 1 3/16"
8" Pin, 1¾" Rod
Top of Tie
8'-0"
5'-2½"
Width of Notch equals width of Bars plus 1/8"
2-9"
37'-0" C. to C. of Trusses
C.L. Track

SUBHANGER DETAIL—CHORD BARS NOT CONNECTED TO FLOORBEAM

As part of the studies for economical and safe design, secondary stresses in the trusses were analyzed. At two places provision was made to neutralize their effect by distorting the truss members during erection. The end section of the bottom chord was bent up 1 1/16 in. at midlength, panel point L1, and the end-post was bent out 1¼ in. at its middle, where the subhanger M1-L1 connects. Thus the end-post and the bottom-chord section were put under negative bending moment



FLOOR HAS A SINGLE SYSTEM OF STRINGER LATERALS AND NO TRACTION BRACING

to an amount equal to the positive moment caused by dead-load and half live-load. When the bridge was swung, that is, under full dead-load, these initial deformations reduced to ¼ in. and 7/16 in. respectively, and they are so computed as to become zero under full train-load on one track. The camber diagram for erection was laid out to secure a level bottom chord under half live-load (that is, full live-load on one track). The camber height at midspan was 13 in., not allowing for falsework compression. (See *Engineering Record*, Dec. 23, 1916, p. 774.)

Directly related to the reduction of secondary stress is the use of adjustable end bearings. Phosphor-bronze rockers were placed under the shoes, to allow free adjustment in both longitudinal and transverse planes during erection. Through such adjustment the great load on the shoes is kept near the center of the bearing regardless of errors in pier levels and distortion during erection. After the span was in place, steel wedges were inserted alongside these bearing blocks to limit lateral motion. The upper shoe is fastened to the bridge chord, so that the end pin (at L0) cannot serve as point of adjustment as the bridge deflects under train load, and the rockers therefore are necessary.

Mountain for Water-Front Fill at Rio de Janeiro

Cutting down the Costello Hill at Rio de Janeiro, Brazil, and using the material to reclaim a large area of submerged land on the water-front, is proposed by a syndicate which has applied for a concession from the government. The engineer is Luiz Barretto Filho, of Sao Paulo, Brazil. The present property on the hill would have to be purchased, but the leveled site and the newly filled site would become the property of the syndicate for development purposes. The cost of removing the 4,700,000 cu.yd. and depositing them in the fill is estimated at $10,000,000. The removal of this hill has been proposed at various times for more than 100 years, the object being to improve the ventilation of the city, as cool winds are now obstructed.

What Moving of Civil Engineers to Joint Home Signifies

Organization Along the Lines of Our Political System, Coöperation and Service to Individual Membership Urged at Welcoming Meeting

ON DECEMBER 7 the American Society of Civil Engineers was formally welcomed to its new home in the Engineering Societies' Building, New York. An account of the meeting appeared in the news section of this journal last week. Herewith are presented extracts from the addresses of William L. Saunders, past president, American Institute of Mining Engineers; George H. Pegram, president, American Society of Civil Engineers; Prof. George F. Swain, past president, American Society of Civil Engineers, and Dr. Rossiter W. Raymond, secretary emeritus, American Institute of Mining Engineers.

Extracts from Mr. Saunders' Address

Mr. Saunders spoke in part as follows:

Let us hope that the union that we celebrate tonight is not merely a physical contact, but that it represents the spirit and purpose of engineers to get together for service, a service not alone in scientific fields, but on the broader plains of civic life.

Let me tell you a true story of recent events at Washington. One of the most important laws which a congress ever enacted is the draft law. This law wisely created boards for the purpose of determining exemptions. This is the court of appeals, the court of last resort, except the President. Each state and territory has one or more district boards. Now, as this war is not only a clash of armies, but a combat between industries, it seems plain that there were many men engaged in industrial work who might render greater service at home than in the trenches abroad. So the advisers of the President succeeded in placing an engineer upon the proposed list of members of each district board in each state in the Union. On these lists were representatives of the farmers, the legal profession, business men and labor. Here was the true position for the engineer, the man who is responsible for the creation and operation of our industries. The engineer members were selected from the organization of engineers which had been created by the Naval Consulting Board in each state and territory, and through which the industrial plants had been surveyed and listed for war service. The President, acting in harmony with our system of government, a government by states, sent these lists to the state governors, asking them to revise them and make such changes in the names as each governor might deem wise.

When these lists were returned to the President, more than 90% of the engineers were scratched off to give place to lawyers and others.

Kind of Organization Needed

It is useless for us to fume and protest at such things as this. It serves us right. We are not organized for civic service. We are not organized for any service. Our institutes, societies and our Engineering Council suffer too much from professional megalomania. Such organizations as we have are not framed to suit the kind of government which we live under—a federation of states, counties and wards—a democracy.

Let us hope that we begin tonight the placing of the corner stone in a structure to be reared on the lines of engineering democracy. Let us get together, not in high places only, not in the branches, but at the roots of the tree; not alone as scientific men, but as technical men doing work as citizens, reaching into every village and every ward—a technical, civic federation. Let us organize, for in organization there is the secret of strength, the basis of influence, and the opportunity for power.

Extracts from Mr. Pegram's Address

Mr. Pegram spoke in part as follows:

We join with you because service to our fellow man demanded it, the advancement of the engineering profession demanded it, the proper development of our members through broader acquaintance and better cooperation demanded it; and in coöperation, we are not half-hearted. We are enthusiastic, as the formation of the Engineering Council attests.

There is a great awakening among engineers as to the necessity of coöperative action for service to the country and to the advancement of the profession that will result. The coöperation we are now instituting must meet that demand. The union of the societies in this home is a happy augury, and the engineers of the next generation will approve of this union.

We realize that the education of the engineer in the past has been too one-sided, and we are encouraged at the present tendency to correct this fault by some attention to the humanities. It is not surprising that while all other classes of the community have been organized for concerted action in their several lines, the engineers have been divided into a number of groups determined by the technical differences in the character of their work. While for scientific progress this must go forward in an ever-increasing degree, for economic progress there must be unity of effort.

It is in this direction that we are moving. We are endeavoring to establish or popularize the profession of engineering. The union which we celebrate is not a step to meet a temporary need, nor the result of a happy thought. It is an answer to a nation-wide call on engineers to get together. Engineers feel that they have not received just public recognition.

Two things are necessary for that recognition: First, the public must be informed of their work. We can trust the public's intuition if the public is informed. And, secondly, there must be a responsible body to encourage that recognition.

Extracts from Professor Swain's Address

Professor Swain spoke in part as follows:

The engineering profession is one profession, and not four; and the opportunity is now before us in better form than it ever has been before to see if we can make ourselves felt in this country and in the world. We

have a building devoted to our uses; we are here in close contact with each other; we have the Engineering Council representing in one body all these four engineering societies, and shortly to represent other great technical engineering societies concerned in the advances of applied science. If, with these conditions, we cannot make ourselves felt, I think it will be very strange.

It seems to me that we have confined ourselves too much to two of the purposes of an engineering society: the advancement of knowledge, the preparation of papers, etc., and the making of a high standard for the societies themselves.

We have neglected two other things which are more important: Making the engineering profession felt as a moving force in the community, and, secondly, doing something more than we have done for the individual members of the profession. I hope that in the future we may able to do both of these things.

Results of Coöperation

I am continually impressed with the fact that a small number of people relatively can, by coöperating and pulling together, achieve immense results. I know of several small bodies of men, who, by organization and hard work, have achieved results which would have been considered impossible. So I do not see why 85,000 or 100,000 engineers—and I am told that there are that number in the United States; these four Founder Societies represent some 30,000 and the number is growing fast every year—I do not see why with so many engineers, if we can only coöperate and pull together, we may not make ourselves one of the most important influences in this country. But we have got to do as Mr. Saunders said. We must organize; we must make ourselves felt in the states, in the counties, in the wards perhaps, in the proper way, in order to realize the results which we ought to accomplish.

Extracts from Dr. Raymond's Address

Dr. Raymond, whose address was punctuated frequently with applause and laughter, spoke in part thus:

I seem to begin to be about to feel that the civil engineers have had taffy enough. If you had sat with me at the eloquent luncheon this afternoon—I call it an eloquent luncheon—I understand it was also savory, but I got there too late for the victuals, and I only heard the speeches—and if you could have heard the rapturous terms in which the civil engineers were made welcome then and there, and add to that everything that has been said in the lobbies and in the halls and what has been so well said already here tonight, you might perhaps suppose that they had had enough. At all events, the thought is rather paralyzing to me, when I am called to welcome them once more.

Having been honored tonight with the duty of speaking for the American Institute of Mining Engineers, it is with personal as well as with representative pleasure that I, in their name, resign the title of senior of the Founder Societies to this great and famous organization, worthy senior of us all.

If we were discussing the thing from the standpoint of the antiquarian, perhaps I might claim general, absolute and irrefutable superiority of antiquity for the mining engineers, because you know primal man first lived in a dug-out—the first man was a mining engineer.

But it is useless to dig among the distinctions of antiquity in order to arrange the order of precedence. The mining engineer is simply an engineer engaged in mining, or connected with some of the arts that are associated with mining. The mining engineer is a civil engineer, plus a mechanical engineer, plus an electrical engineer. He has all the problems that torment those engineers, together with a torturing lot of his own that they don't have.

New York a Mining Camp

It is very pleasant to us to have this fact so thoroughly acknowledged as it has been in these latter years. The City of New York, as perhaps you have been told before, has been for the last few years the greatest mining camp on earth. During that period, with its immense system of subways and with its new water-supply from the Catskills and with its deep cellars under its lofty skyscrapers, New York has literally and not figuratively employed more miners and trained more mining engineers than any other mining field on this green globe—and we have made good mining engineers out of civil engineers. I can tell you that there is no such good raw material for a mining engineer as a real, thorough civil engineer. The great engineers that have designed, constructed and conducted the immense public improvements in this municipality within the past 20 years have not only taken up and acquired the art of mining engineering, but they have adorned it with new methods and with new achievements, before which we regular, trained, born mining engineers take off our hats.

At least, that is the opinion of the late Professor Christy, dean of the greatest mining school in the country, I think not even second in numbers to our own great school at Columbia. Christy, after making a pilgrimage around the world, stopping at New York on his way, found more new and novel methods of mining in New York City, in our subways and under our pavements, than he had found elsewhere on the whole globe; and he wrote to me that such civil-mining engineers as Barclay Parsons were teaching us a new science of mining engineering.

He had been underground where the rock was so rotten that it could not be either held up or bored through; and he found that they were squirting cement into the interstices of this rotten, old gneiss and making an artificial stone of it, much superior to the kind the Almighty had made—that is to say, after nature had had its way in weathering it for a few thousand aeons. They had consolidated this rotten mass until it was made into a splendid new mass of rock, and in that rock had made our subway tunnel with safety.

Not only to pierce the crust of the earth, but to create it in order to pierce it, is a double art, for which we mining engineers here and now desire to thank the society of civil engineers for having invented a new thing in our line.

Opportunities Furnished by Mining

You can glance over, I won't say the world—you don't want to cast your eyes around the world in its present disturbed condition—but confine yourselves to our continent and our country, and see how the business of mining engineering, how the art of mining and the

business connected with mining, is breeding great engineers.

Electrical engineering? If you want to see electrical engineering, go with me to Montana and view the River Missouri lighting and pumping, hoisting and driving the machinery in the mines of half a continent. And the whole of the vast, imperial State of Montana, and the still more imperial State of Washington, how they have harnessed into their electrical team the "Father of Waters" himself!

You electrical engineers would cut a small figure if we did not start the mining enterprises that made you necessary, and subsequently made you wealthy and—complacent!

Mechanical engineering? What is the greatest achievement of mechanical engineering that can be seen today by the eye of man? The magnificent system of handling materials by which a ton of iron ore can be taken by the steam shovel out of the mine away in Minnesota, and brought over land and over lake, and landed and relanded and piled and repiled; taken to the blast furnace and hoisted to the tops of the blast furnaces, and melted in the furnaces, and run from the bottom of the furnaces, and carried as pigs into the bessemer converter and out of the bessemer converter into the rolling mill, and out of the rolling mill to the railroads, and from the railroads to the track—from the time it left its mother earth until the time it lay again upon its mother earth, to be the support of the traffic of man—and all without the direct touch of a human hand! A very small figure in the world would you electrical and mechanical engineers have cut if you had not had a chance to do these big things; and who gave you the chance? The mining engineer!

Now, we do not claim, we are not asking for, a greater share of glory than belongs to us. We do not want a bigger share—we want it all. And we want it all because there really is not any line of difference between you and us. We claim Barclay Parsons, for instance, as a great mining engineer. But if you have given us Barclay Parsons, we have given you Arthur Dwight; and if Parsons stands tonight the lieutenant-colonel of the 11th Engineers in France, Arthur Dwight is his next in command.

Soldier Engineers

Oh, it was high time that you civil engineers came to the house where you belonged—it was high time! It is an auspicious omen that this event, symbolizing the greater unity—unity in variety—among American engineers, takes place at the moment when that unity is showing itself in the achievements of patriotic courage, under the flag of many in one.

The old First Engineer Reserve, now the 11th Railway Engineers in the U. S. Army, has covered itself, and us who created it, with glory already. I, who had seen American railway builders lay eight miles of standard-gage track in a day, felt sure that our boys would open the eyes of Europe to the art of laying rails; and I was not surprised when Field Marshal Haig announced the other day that the engineers behind Byng's advancing line deserved as great a share in the credit of his victory as the infantry that made the victorious charge; because the engineers, working under fire, though without weapons of defence, kept up with the advancing troops, performing miracles of rapid construction on the railroad lines of supply.

In fact, the very contretemps of last week is proof of that. How came the American railway engineers to be trapped between two lines of battle? Because they and their tracks and trains were clear up at the front, instead of struggling in the rear to catch up with the army. And as our hearts thrill with the story of the hair-breadth escapes, the dashing rescue, the gallant, loyal courage of those who laid down their picks and shovels to borrow the rifles of the wounded and the dead, we take off our hats to the *Soldier Engineers* of America—a new class, which includes all the rest. If you ask further instances of our patriotic coöperation, let us remind you that we have given to the world Herbert Clark Hoover, the American mining engineer.

All Engineers Simply Engineers

The distinctions and differences between us had crumbled so that there was nothing between us but the distance of a few blocks in New York City, a division that had no meaning whatever. I tell you now that all engineers are simply engineers. The mechanical engineers are engineers dealing with mechanical matters; the electrical engineers are engineers dealing with electrical matters; and the mining engineers are engineers, as I have just now explained to you, covering everything else that all the rest of you do and dealing with mining matters. And we are all engineers.

There is a higher unity still, and that we reached very recently, just about the time we began to build the addition to this building. We are all patriots; we are all Americans; and I want you to notice that while there are special distinctions in the titles of these societies, there is one word that belongs to all. They are the *American* institutes and the *American* societies

Well, we welcome you to the house where you ought to have been before, and we tell you it is a good house to live in. We that have lived in it since the beginning know how good a house it is; and I want to blow the trumpet a little for the good old house. I want you to understand that you have not merely come together with a lot of fine fellows, coöperation with whom will be mutually most advantageous, but I want you to understand that you have come into the most magnificent house that ever was built on earth for engineers.

Shortly after this house in its first form was finished, a great London architect traveled around the world to view the modern architecture of man. He came here, or, rather, he came the other way; he came from Australia here, and he went to Canada, and he came through the United States, and at last he came through New York. Finally he went home, and after he reached London, he delivered before the London Society of Architects an address in which he praised and criticized with equal freedom. He praised thoroughly and he blamed thoroughly. I remember now but one sentence of that lecture. He said that of all the buildings he had seen upon his journey, one only was perfect; in proportion, design, detail and adaptation to its purpose. That perfect building was the gift of Andrew Carnegie to the engineers of America. . . .

Yes, we welcome you to the fellowship of engineers. We welcome you to the brotherhood of patriots. We

welcome you to a happy family that does not have to take opiates to suppress its natural instincts. We live together in comfort.

As far as quarreling is concerned, you know what Whistler said—I was reading it only the other day—one of the witticisms of that great artist: "Quarreling with your enemies is vulgar; quarreling with your friends, that is gentlemanly." That sort of thing we can do in style; but you will find that there is substantial unity—unity in variety. E pluribus unum—many floors, one elevator!

When I was a student in the last century somewhere—somewhere in Italy—our landlord undertook to celebrate Thanksgiving Day for us American boarders. He was very proud of having lived in America; he had been a cook over here; and he had learned how to cook turkey. He procured a turkey and brought it into the banqueting room on Thanksgiving Day. He had it decorated and garlanded and paraded it with all ceremony in a procession round and round the room until it was finally deposited on the table before us, and then we found that he had planted crosswise in the breast of the turkey two American Star Spangled Banners, with a scroll on which he had printed with great care and distinct clearness the words E PLURIS UNIBUM!

Now, that is the sort of company to which we welcome you, a company that is so much like yourselves, as I have said before, that you cannot know the difference.

You are one of the largest fractions of it, and the total is just like the fractions. You cannot add shillings to dollars and cents; you have got to have your coinage all alike before you can count your money. And, therefore, we, who are about to live more happily than ever, salute you.

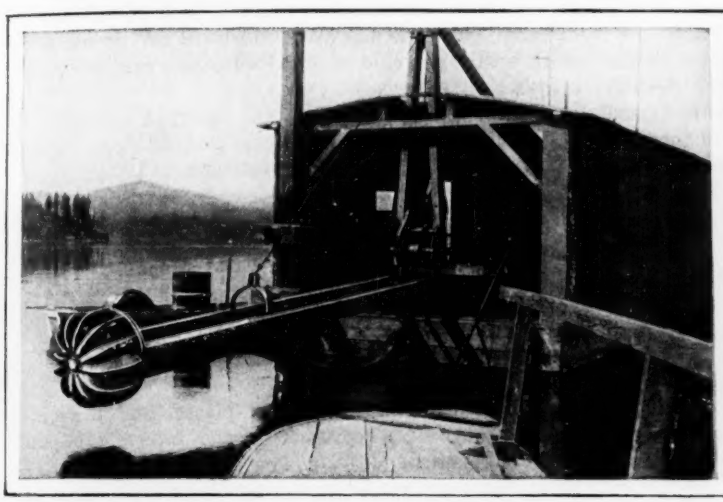
Correction of Concreting Record

The placing of concrete in the foundation of the Felt & Tarrant Building, Chicago, was done at the rate of 275 cu.yd. per 8-hr. day, and not 27.5 cu.yd as stated in *Engineering News-Record* of Dec. 6, p. 1066.

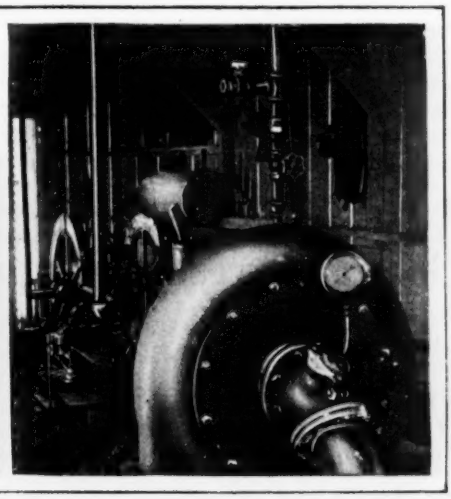
Home-Made Dredge Reduces Cost of Canal Construction

Crew of Two Men Excavates 35 Cubic Yards per Hour with a Small Suction Machine of Unusual Design

IN CONTEMPLATING the construction of several miles of canal near Spokane, Wash., it was found that the use of the ordinary trenching machines was not feasible and that the canal section was hardly large enough to make the use of a floating clamshell dredge economical. The canal was to be 20 ft. wide at water level and 12 ft. wide at the bottom. The excavation required, allowing for a small ditch already built along the route, amounted to about 2 cu.yd. per linear foot of canal.



HOME-MADE SUCTION DREDGE WORKING IN CANAL



INTERIOR OF DREDGE WITH CENTRIFUGAL PUMP

It was decided to built a cutter suction dredge small enough to float in the canal and which could be operated at low cost. Accordingly, a 12 x 40-ft. barge was built with sides and ends of 6 x 12-in. Douglas fir timbers drifted together with ½-in. drift bolts. The bottom was made of 4-in plank well spiked to longitudinal beams that constituted the frame. The barge was built bottom side up and then turned over and after being carefully calked was decked with 3-in. plank.

The cutter arm, 22 ft. long, was made of two well braced 6 x 8-in. beams carrying a 1½-in. shaft for driving the rotary head. The suction pipe to the cutter consisted of a flexible armored hose 6 in. in diameter leading to a Byron Jackson Rock pump. This pump was operated at about 350 r.p.m. by a 24 hp., type G, Fairbanks Morse 4-cylinder gasoline engine, geared down from 800 r.p.m. The discharge line, laid along the canal bank, was a 9-in. flanged pipe whose length ranged from 30 to 50 ft. in the course of the job. Owing to dikes along the old ditch, the equipment had to be built to handle material under heads up to 22 feet.

The barge was also equipped with an 8-hp., type N, Fairbanks Morse gasoline engine for driving the cutter head. This was geared down so that the cutter turned at a comparatively low speed. When desired, this 8-hp.

engine could also be used to drive a small Goulds vacuum-pump used for priming the large pump. The suction from the priming pump was led up through the roof to a height of 33 ft. above the deck and thence directly down to the top of the main pump casing. This arrangement made it impossible for the vacuum pump to draw water into it even after the main pump casing was filled with water, and was used simply to safeguard the small pump.

The cutter arm was hung in supports in such a way that it could be raised by a hand-operated crab and could be swung to right or left by a bull wheel driven with belt and gear drive from the 8-hp. engine.

A universal joint in the cutter driving shaft had been provided at the base of the cutter arm so it could operate in any position. The barge was held in position by a single 8 x 8-in. steel chord, spaced on one corner of the front end.

The method of operating the dredge was to swing the cutter head slowly from side to side until the desired depth had been reached. Then the arm would be raised and the slight current flowing from the canal into the small ditch already in use was sufficient to move the barge forward as desired as soon as the speed was raised by a small hand crab provided for that purpose. This system of advancing greatly expedited the progress of the work.

On this plan the dredge advanced an average of about 16 ft. per hour. It is believed that the pump often handled as much as 30% solid matter. The material encountered varied from coarse gravel to hardpan. This progress was greater than that made by a ½-cu yd. clamshell dredge operated on part of the canal, although the larger dredge had a crew of four and cost much more to operate. With the suction dredge the yardage for a good day's run was 680 cu.yd., handling an average of 20% solids. The wages of the crew of two men amounted to $7.50 and fuel for the engines cost $5.40. Thus the labor and fuel costs were slightly more than 2c. per yard. The dredge was built for a 2½-mile length of canal, but as it was used afterward for maintenance work a salvage value of about 58% was credited to the contract.

The small suction dredge was designed and built by C. L. Wickstrom, consulting engineer, Spokane, Wash., who supplied the foregoing information.

Good Progress Made in Operation of Federal-Aid Road Act

Many Questions Incident to Its Understanding Are Now Settled—Meaning of "Post-Road" Defined—Projects Are Being Approved Rapidly—Some States Must Hurry

WHEN President Wilson signed the Federal-Aid Road Act on July 11, 1916, he rendered effective a measure unique in the annals of American legislation. It involved not merely the granting of financial assistance to the states in the building of their public roads; it went much further and placed on trial a far-reaching policy of coöperation between the Federal Government and each of the 48 states, said Logan Waller Page, director of the Office of Public Roads and Rural Engineering, in an address, delivered before the annual meeting of the American Association of State Highway Officials, which is given here in full.

This measure undertook to lay down the conditions which should govern the coöperation, and it specifically called for affirmative legislation by 48 other legislative bodies than Congress. It placed the administration of the act in the hands of 49 agencies comprising the Secretary of Agriculture and the highway department of each of the states. On the one hand, therefore, we have the manifold difficulties incident to the adjustment and smooth operation of a plan which requires action by so many different agencies, and on the other hand we have all the possibilities for good incident to the powerful cumulative effort which may thus be put forth by all of the forces of the nation working in unison.

Only by broad-minded and generous dealing with each can we accomplish the great work cut out for us by the Federal-Aid Road Act. Only by a disposition on the part of state and Federal officers to overlook the small troubles and difficulties which arise, and to consider whether the plan is working out in a fundamental sense, can a true perspective of the practical results be obtained. The Federal officials are endeavoring to put themselves in your places, and to act as though they were representing the interests of each state in its turn. If you likewise will put yourself in their places and consider your problems from the standpoint of the nation, we shall then have placed ourselves in that frame of mind which will best insure a friendly coöperation.

First, let me call your attention to the fact that the beneficial results of the Federal-aid legislation are not to be measured merely in the miles of improved roads built with the aid of Federal funds. I would consider that secondary. The most important result has already been accomplished in the form of an immense amount of constructive state legislation, establishing and strengthening state highway departments, providing skilled supervision, systematizing road work in the states, establishing maintenance funds, and in many other ways insuring the efficient and economical handling of the nation's road problems. I need not go into detail to convince you not only that these results have been accomplished, but that the Federal-Aid Road Act has been a powerful factor in their accomplishment.

Turning now from the influence of the act upon state legislation, I will deal briefly with what has been done by the Federal Government in the administration of the act. A great many people had the impression that within a few weeks after the measure was placed on the statute books money would begin flowing into the states and the building of Federal-aid roads begun. At the risk of burdening you with details with which most of you are already familiar, I shall set forth some of the preliminary work which the act specifically required before road building could be undertaken. First,

it was necessary that the Secretary of Agriculture certify to the Secretary of the Treasury and to the state highway departments the amounts apportioned to each state, and to do this necessitated the obtainment from the Postmaster General of the mileage of rural delivery and star routes comprising one of the factors of apportionment. Next, it was incumbent upon the Secretary of Agriculture to formulate rules and regulations for carrying out the act. This was no small task, as it was desirable to obtain the views of the various state highway officials, as well as to apply to it the knowledge of the Federal officials. As the act called for coöperation between the Secretary of Agriculture and state highway departments, it became necessary to ascertain by an exhaustive examination of state laws what states were equipped with highway departments within the meaning of the act. This required time and an immense amount of careful and painstaking investigation.

No Highway Departments in 11 States

As a result of the examination it was found that there were eleven states which were without highway departments in the sense contemplated by the Federal act, and that the highway departments of five other states might be considered as in the doubtful class. You are sufficiently familiar with the act to know that it required as a preliminary to coöperation an assent by each of the state legislatures, and that it made certain specific requirements; for example, that the work should be done under the direct supervision of state highway departments, that funds should be provided by or on behalf of the state, and that adequate maintenance provision should be made. Few of the states were in position, when the act was passed, to coöperate.

But you are no doubt more concerned with the specific difficulties which you have encountered in the operation of the act than with any narrative which I might set forth. Touching briefly upon these, it has been made clear that foremost of all the difficult questions that have arisen is that of determining what constitutes a rural post-road.

Almost as soon as the measure became effective widely varying interpretations of the term, "rural post-road," were current. It was asserted by some that it meant only those roads on which the mails were actually carried; by others, any road over which it was physically possible to carry the mails; and by still others, any road on which the mails were actually carried or on which there was a prospect that they soon would be carried. Manifestly, the question was one purely legal in character, and the act could be interpreted authoritatively only by the qualified legal officers of the Federal Government. We went to the Attorney General with our troubles and we asked him to advise us as to the eligibility of certain classes of roads which had been submitted. These classes were (1) where the mails were actually carried over the road (2) where the mails were not carried, but where there existed a reasonable prospect that they would be carried within a reasonable time after the completion of the road (3) where the proposed road was an entirely new location, but there existed a reasonable prospect that mail would be carried within a reasonable time after the completion of the road (4) where the part or parts of a project on which no mails were carried constituted an unsubstantial portion of the whole and it would be uneconomical to build the parts on which the mails were carried without building the other parts, even though no prospect existed that these unsubstantial parts were ever to be used for carrying the mails. The Attorney General decided that all roads in those four classes were eligible as post-roads.

Even then our difficulties were not at an end, for the questions arose as to what constituted a "reasonable prospect" and an "unsubstantial part of the whole." Finally we drew up instructions as detailed, as we felt the regulations and the opinions of the Attorney General would permit, for the use of our district engineers. Merely as a guide and not as a rule, we advised (1) that where the unused portion of a project was comprised in several or a number of short sections, concerning which no prospect of their use by mail routes existed, the project might be worthy of approval if these short unused sections did not aggregate more than approximately 30% (2) that where the entire project was inconsiderable as to mileage, the parts not used and concerning which no prospect could be shown might aggregate as much as 30% (3) that where the unused portion consisted of one or two parts not on the end of the project they might aggregate approximately 2% of the entire project (4) that where the unused portion consisted of one part at each end of the project and connected with a small town or city or an improved road or another post route, such portion might comprise approximately 20% of the entire project (5) that where the unused portion concerning which no prospect existed comprised a stretch at one end of the project connecting with a large city, it might comprise approximately 10% of the total length of the project.

Actual Cases Illustrate Trouble

We have tried in every way possible to find ways and means for making the post-road provision of the act as reasonable as possible within the law. You can hardly blame us if we have had to do this in some measure step by step. The Attorney General and other law officers of the Federal Government do not deal with purely hypothetical questions, and it is necessary therefore that we submit to them genuine cases so that they may see the actual troubles which we are trying to remedy.

I am gratified to be able to say, however, that with all of its troubles the post-road provision has served to disqualify a very small percentage of the projects submitted. This is proven by the fact that out of a total number of 228 projects submitted by the state highway departments to Nov. 30, 1917, inclusive, 168 have been approved and only 6 have been disapproved. You can see, therefore, that the trouble is not so serious as a casual consideration might make it appear.

Questions have arisen in connection with state laws which have been productive of some delay, and I have heard the contention that the Federal Government should take it for granted that the respective state highway departments are complying with the laws of their states, and we should therefore hold the state highway departments only to a compliance with the

provisions of the act. This contention is sound, except insofar as the act itself calls for certain conditions to be met in certain ways by the states. I have already mentioned the fact that the act permits coöperation with the state highway departments only. Now it is necessary, not only that the Secretary of Agriculture determine whether or not a state has a highway department, but who and what constitutes the department. He must assure himself that he is dealing with those persons constituting the highway department, and with no others. If, therefore, a state law prescribes that certain officials, organizations or individuals shall have certain duties and authority in connection with the regular personnel of the recognized highway department, the Federal Government must deal with them according to the provisions of the state law.

I have already mentioned to you that the work must be done under the direct supervision of the state highway department. It follows that the Federal Government cannot deal with the state highway department in matters over which that department has no jurisdiction. It is a simple and reasonable requirement, therefore, that the state highway department gives assurances that it has the supervision contemplated by the Federal act. It is no less a duty of the Federal officials to ascertain how the funds are to be provided by or on behalf of the state, and that the depository is authorized as required by the act to receive state and county funds. This matter has received the most careful study by the Secretary of Agriculture, and I am glad to say that henceforth we shall be able to simplify the steps by which these requirements may be met.

Office Anxious to Start Work

We have had much trouble in the matter of obtaining plans, specifications and estimates promptly following the approval of the project statements, so as to enable the agreements between the Secretary of Agriculture and the state highway departments to be executed without delay. We have had inquiries from time to time from interested parties urging the Government to allow the work to proceed without further delay, when as a matter of fact we were as anxious as the inquirer to have the work start, but we could not authorize the commencement of construction until plans, specifications, and estimates had been submitted and approved. Our requirements are reasonable as to plans, specifications and estimates, and if they are reasonable, certainly there should be no difficulty on the part of the states in supplying the information which we seek. If any of our requirements in this connection are unnecessarily burdensome upon the states, I trust they will be freely and frankly brought to our attention. Our chief engineer, his assistant, and our ten district engineers are all here ready to discuss these questions and to have the benefit of any advice or suggestions that you may have to offer. Incidentally, I may say that of 168 projects approved only 88 sets of plans and specifications have been submitted. Of this latter number, 72 have been passed by our engineers and recommended for approval, so that only 16 sets of plans and specifications submitted are now pending.

You may be interested, however, in knowing the status of the individual projects as of this date. I have had prepared a table showing by states the number of projects submitted, the number approved, the number covered by project agreements, the amounts of state and Federal funds involved in the projects. The balances remaining of the allotments to the respective states may therefore easily be ascertained. I would call your attention to the grand totals showing that 228 projects have been submitted, 168 approved, and 6 disapproved. The amount of Federal aid involved in the projects submitted is $5,664,442.31, the total including state and local funds $13,583,577.98, and that the total approved is $4,052,142.85 Federal funds and $9,770,179.40 Federal, state and local funds. In this connection I would call your attention to the fact that those states which had highway departments at the time the apportionment was made for the fiscal year ending June 30, 1917, must enter into project agreements on or before June 30, 1918, or the amount allotted to them and not covered by project agreement will be reapportioned under the terms of the act to all of the states. I would suggest that you examine into this question very closely as a comparatively short time exists for you to save this first year's apportionment to your state.

FUNDS APPROPRIATED, MILEAGE AND STATUS OF FEDERAL-AID ROAD PROJECTS—COMPLETE TO NOV. 30, 1917

State	Projects Submitted	Projects Approved: Number	Projects Approved: Federal Funds Involved	Projects Approved: Total Funds Involved	Projects Approved: Miles Involved	To Nov. 30, 1917: Project Agreements	To Nov. 30, 1917: Plans, Specifications, Estimates Submitted
Alabama	28	22	$235,012 91	$482,022 22	145 86	8	15
Arizona	1	1	57,899 89	115,799 79	(bridge)	1	1
Arkansas	8	7	102,434 71	251,255 37	33 03	7	7
California	5	2	60,827 20	125,378 06	6 78	2	2
Colorado	7	5	100,982 20	215,426 33	80 53	..	1
Connecticut	2(a)	2	78,400 00	217,969 29	7 8	1	1
Florida	2	2	32,500 00	92,220 60	14 43	..	1
Georgia	5	5	167,798 93	336,545 84	124 03	..	..
Idaho	1	1	75,000 00	190,410 00	57 0	..	..
Iowa	8	4	82,512 60	251,760 88	52 07	1	1
Kentucky	2	1	67,593 82	135,187 65	8 13	..	..
Louisiana	7	5	140,924 02	410,197 49	77 48	..	4
Maine	3(a)	2	158,063 53	335,822 94	15 53	1	1
Maryland	4	4	93,050 21	202,436 98	9 66	3	4
Massachusetts	6	6	114,390 36	257,253 74	12 44	3	5
Michigan	7	5	293,419 75	586,839 50	83 94	1	3
Minnesota	14	13	365,840 52	753,919 36	252 01	2	5
Mississippi	7	5	85,164 28	197,211 46	77 0	..	..
Missouri	3	3	62,556 33	250,225 34	39 7	..	..
Nebraska	2	1	17,847 50	204,683 05	5 5	..	..
Nevada	4	..	..	..	..	..	..
New Hampshire	8	8	58,668 91	117,337 84	12 24	3	6
New Jersey	1	1	59,212 68	164,988 01	9 7	..	..
New Mexico	11	1	5,287 99	10,575 99	3 0	..	..
New York	5	4	227,843 55	455,687 10	22 87	..	..
North Carolina	14	12	93,500 00	286,400 87	96 12	3	3
North Dakota	2	2	13,612 50	27,225 00	32 0	..	..
Ohio	7	7	382,073 00	1,229,579 28	39 01	2	7
Oklahoma	1	1	50,029 37	100,058 75	25 0	..	..
Oregon	4	1	19,032 75	38,065 50	4 8	..	..
Pennsylvania	7	4	195,750 00	528,432 45	19 58	4	4
Rhode Island	1	1	34,997 13	85,444 16	3 66	1	1
South Carolina	5	5	134,610 37	284,229 02	27 06	..	3
Texas	6	..	..	..	..	..	..
Utah	1	1	38,700 00	77,400 00	45 0	..	..
Vermont	9	9	52,142 58	104,885 19	12 56	..	1
Virginia	4	4	57,976 39	133,053 38	19 42	3	3
Washington	7	7	215,652 72	460,843 36	39 94	2	6
West Virginia	1	1	9,246 48	30,912 29	2 53	..	1
Wisconsin	3	..	..	..	..	..	2
Wyoming	5	3	11,287 67	22,575 32	28 72	..	..
	228	168	$4,052,142 85	$9,770,179 40	1,546 12	48	88

(a) Connecticut Project No. 2 and Maine Project No. 2 withdrawn after approval.

Intense Study of Highways Forced by Circumstances

Greater Need of Coöperation in Experimental Work—Changes Induced by Heavier and Speedier Traffic Outlined—Several New Types Described

CONSERVATIVE people may question the need for many of the recent changes in the design and construction of highways. It is even a frequent reproach to highway engineers that they waste good money in futile experiments, yet the roads that exist today afford only too great evidence of the need of improvements that can come only through change, says H. E. Breed, First Deputy Highway Commissioner, New York State, in a paper read before the annual meeting of the American Association of State Highway Officials, from which the following has been condensed.

There are legitimate reasons why so many changes are being made: In the first place, engineers are thinking along different lines. Different experiences and different conditions of soil, climate, weight and density of traffic have to be met. In large measure, each man has had to learn through his own experience, and in this process has often repeated mistakes of others, which might have been easily avoided if there had been a more thorough interchange of information. Lack of this results in much duplication of experiments with the consequent waste of money. One of the great values of such an assembly as this is the interchange of ideas which it effects and the tendency toward standardization of work which it inspires.

Second, the conditions are constantly changing, due chiefly to traffic. The increase in quantity of traffic comprises the natural increase, which each improved road brings to itself, and the further increase that it invites when it becomes a link in a completed system. Today war conditions, military needs, and the lack of adequate railroad facilities forces an even greater traffic upon the highways in many localities.

And as the quantity of traffic increased, its character also has changed. A few years ago the steel-tired horse-drawn vehicle carrying a load of approximately three tons was the greatest destructive factor. Then came the pleasure car, whose rapid movement made necessary a surface which should be dustless and possess high cohesion. Next, the motor truck of 15 to 20 tons required stronger foundations and heavier types of construction, as well as a greater integrity of surface. And now the steel-tired, as well as the rubber-tired trailers, with greater wheel loading even than the motor truck, must be considered in designing.

Heavier Foundations Needed

Such changes as seem uniformly desirable for all types of pavement are primarily those which affect public safety and commercial expediency. These are: First, depth of foundation. This new and heavier traffic has cut through and broken the old 6-in. waterbound macadam, which for years was thought adequate for all needs. The waterbound macadam roads of the French war front have shown astonishing endurance because they have had such splendid foundations. At present they are being built 2 to 3 ft. thick to enable them to carry the concentrated military traffic. This tendency to strengthen foundations can be noticed everywhere, and is unquestionably necessary under the weight and impact of modern high-speed traffic.

Second, more complete drainage. It has been found possible in many cases to render the soil so stable through proper drainage that it is able to withstand the extra loading imposed upon it. In flat country, large ditches as much as a half a mile long have sometimes been dug for this purpose—a number of miles of the Coleman-DuPont roads in Delaware are good examples of this expedient.

Third, banking of curves. Objections are raised to this growing practice on the ground that it encourages people to travel at high speed, but the banking of curves certainly makes the roads safer to the careful person driving under strange conditions. In New York State 16-ft. roads have been widened or "mooned" so that in many cases where the radius is small the actual curve is as much as 24 to 28 ft. wide. Furthermore, this gives an increased range of vision, the super-elevation makes steering easier, and the likelihood of skidding is lessened to a noticeable degree.

Fourth, split curves. Sight distances cannot be secured in some cases where the curve is sharp and dangerous. In order that the traffic might be held to its own side of the road, the curve has been separated and a curbed parking provided.

Fifth, approaches to bridges, to grade crossings, and at intersections. If the grade crossing of a railroad is above the roadway proper, it is safer if the roadway be carried out level for 25 ft. or more on each side of the track, so that it may not be necessary to change gears in so dangerous a place. Bridge approaches should have a level stretch of road before the bridge floor is reached, and this should be as long as is economically possible. Street intersections also should be approached as nearly on the level as is possible. Greater safety is secured by cutting the corners to a longer radius.

Sixth, danger signs. To accomplish their purpose, and not be in themselves a danger, these signs should be visible day and night, and should be placed at standard distances from the conditions to which they call attention. There has been a tendency to a more frequent use of guide signs, which in all cases should be large and legible enough to be read easily at the average speed of travel.

In what I have said above, I have interpreted the subject assigned me rather liberally to mean the finished highway. I come now to a more literal interpretation in considering changes in design and construction of specific types of pavement.

Larger Stone For Waterbound Macadam

There has been a general tendency to increase the size of the stone in waterbound macadam, bituminous macadam, penetration method and concrete pavements, from 1½ in. to 2½ in. A larger amount of the product of the crusher is made available, thereby cheapening the cost

of the top coarse stone as well as producing a better surface containing more stone, and having less tendency toward raveling.

A method used during the past few years in the construction of waterbound macadam has been to form the last puddle with light cold tar, or light cold oil. This has the advantage of strengthening the surface bond, as well as making the road dustless. Maryland has some of this class of road, and from reports it appears very satisfactory.

Another method is to treat all waterbound macadams with calcium chloride, and give it a surface treatment of light cold tar, or light cold oil. All work that has been properly puddled and bound, and has been opened to traffic for three to six months, should be swept clean, given a surface application of bituminous material, and covered lightly with stone chips or coarse sand. This forms a mat or cushion on the surface, preventing it from disintegration or raveling. Those parts of the surface that are not seasoned enough to receive the bituminous material should be treated with 1½ lb. of calcium chloride per yard. Later, if necessary, a second application of 1 lb. per sq.yd. should be applied. This will maintain the integrity of the surface until the following year, when the surface can be treated with tar or oil under maintenance.

Vary Methods on Tar and Asphalt

Until the last three years the penetration type of bituminous macadam was built in many cases under practically the same specifications whether asphalt or tar was used, even though asphalt generally stays near the surface, bleeding up in warm weather, while tar has a tendency to work down, leaving no material to prevent surface disintegration. One experiment made to avoid this consequence was made on a road built by the writer. After the proper thickness of stone had been spread it was lightly rolled once to shape it. It was then filled with No. 1 and No. 2 stone in an amount just sufficient to fill the void. The top course was rolled again after which the tar, heated to a temperature of between 200 and 300 deg. F., was applied. The amount of tar for this application approximated 1¾ gal. per sq.yd. for a compacted top course 3 in. thick. The surface was immediately covered with a layer of clean No. 1 and No. 2 broken stone mixed, after which it was again rolled and additional No. 1 and No. 2 broken stone applied and broomed into the voids until the No. 3 or top course was entirely filled. After this was done, all loose stone was swept from the surface and a seal coat of approximately ½ gal. of tar per sq.yd. was applied. The road was immediately covered with No. 1 broken stone which was spread and broomed, and again rolled. The rolling was continued and additional No. 1 stone added until a smooth, uniform, and thoroughly compacted surface was produced. The first road on which this was tried is now two years old and has been under average heavy traffic. The results are exceptionally good, so that all of our penetration work done with tar will be constructed according to the same specifications.

Another good method of lower first cost where the local stone is not of good enough quality for top surfacing, is to place a veneer top of ¾-in. trap rock, or some other stone of high quality, on the ordinary top course after the first pour of bituminous material is completed. This course should be from ¾ in. to 1 in. thick and poured and finished with the usual squeegee course.

There have been two changes in the mixed surface type of bituminous macadam recently. Where there is to be a large amount of motor traffic less asphalt is used because of the large amount of oil dropped over the pavement by motor vehicles. Another method which has been used to some extent is that of rolling hot stone varying in size from ½ in. to ¾ in. into the surface of a Topeka pavement.

Belt Finish for Con rete

In finishing concrete pavement surfaces the belt has largely taken the place of floating and also of the finishing machine. It is cheaper than either of the other methods and at the same time gives a good, smooth, easy riding surface. The advocates of the roller method claim that, on account of the importance of a proper water content, the roller, if properly used, will not only give a good finish but also greater strength, taking out the excess water and result in a satisfactorily stiff mixture which it is impossible to use in most concrete road construction.

A tendency in brick surfacing that, from an economic standpoint has many advantages, is the use of 3½- or 3-in. brick in place of the ordinary 4-in. paver. In the use of the 3-in. brick there is a saving of ¼ in the freight charges and a consequent saving in handling. This type of work in a number of instances has given every indication of being satisfactory. Some work under consideration may use 2½-in. and even 2-in. brick, and if successful the resulting economies will make brick pavements feasible in many localities where now they are uneconomical.

In even this cursory review of recent changes I cannot conclude without reference to the development of laboratory work in relation to road surfacing. There should be laboratory control in connection with every piece of highway work. To insure good work all materials should be up to a standard which has proven its adequacy in service. Field tests by men in charge of the work should be made in parallel with laboratory tests to keep a constant check upon the materials going into the work.

As a matter of cost it may not be entirely practical for every department in its early stages of development to have a fully equipped laboratory, but if there is a sufficient demand for laboratory work, the commercial laboratory in existence would certainly be willing to equip themselves to render this service at a nominal charge. This would stabilize all work, and the amount expended would be the cheapest kind of insurances.

Ownership of Austin Water-Supply Springs

In the article entitled "Water-Supply 'Gift' May Prove Expensive to Austin," in *Engineering News-Record* of Dec. 6, p. 1056, it was stated that the springs mentioned in the article "are owned by a defeated candidate for the office of mayor of Austin." This should have read that the "springs are owned by a party who is very much opposed to the present city administration—so much so, in fact, that at the last election he got out candidates in opposition to the present incumbents."

Chicago Reinforced-Concrete Flat-Slab Ruling Amended

New Ordinance Changes Certain Features in Standard Method of Figuring Girderless Floors—Comment on Ruling by Building Department Engineer

THREE years ago, on Aug. 18, 1914, the commissioner of buildings of Chicago signed a ruling on the design of the reinforced-concrete flat-slab floor, which has been most widely used under the name of the "Chicago Ruling" as a standard method of computing for this type of construction. In the three years of its use the need for some modifications, mainly in form or in enlargement of scope, has become apparent, so the Department of Buildings has now revised the ruling to include the later information. The new ruling, issued by Charles Bostrom, commissioner of buildings, is to become effective Jan. 1, 1918. It is printed in full herewith, followed by an explanation of the revisions, by John Krippner, bridge and structural engineer in the Building Department. The first ruling was printed in *Engineering News*, of Sept. 24, 1914, p. 632.

Definitions

(1) Flat slabs as understood by this ruling are reinforced-concrete slabs, supported directly on reinforced columns with or without plates or capitals at the top, the whole construction being hingeless and monolithic without any visible beams or girders. The construction may be such as to admit the use of hollow panels in the ceiling or smooth ceiling with depressed panels in the floor.

(2) The column capital shall be defined as the gradual flaring out of the top of the column without any marked offset.

(3) The drop panel shall be defined as a square or rectangular depression around the column capital extending below the slab adjacent to it.

(4) The panel length shall be defined as the distance c. to c. of columns of the side of a square panel, or the average distance c. to c. of columns of the long and short sides of a rectangular panel.

Columns

(5) The least dimension of any concrete column shall be not less than one-twelfth the panel length, nor one-twelfth the clear height of the column.

Slab Thickness

(6) The minimum total thickness of the slab in inches shall be determined by the formula: $t = W^{\frac{1}{2}}/44$ (= square root of W divided by 44), where t = total thickness of slab in inches, W = total live load and dead load in pounds on the panel, measured c. to c. of columns.

(7) In no case shall the thickness be less than $^1/_{32}$ of the panel length ($L/32$) for floors, nor $^1/_{40}$ of the panel length ($L/40$) for roofs (L being the distance c. to c. of columns).

(8) In no case shall the thickness of slab be less than 6 in. for floors or roofs.

Column Capital

(9) When used the diameter of the column capital shall be measured where its vertical thickness is at least 1½ in. and shall be at least 0.225 of the panel length.

The slope of the column capital shall nowhere make an angle with the vertical of more than 45°. Special attention shall be given to the design of the column capital in considering eccentric loads, and the effect of wind upon the structure.

Drop Panel

(10) When used, the drop panel shall be square or circular for square panels and rectangular or elliptical for oblong panels.

(11) The length of the drop shall not be less than one-third of the panel length ($L/3$) if square, and not less than one-third of the long or short side of the panel respectively, if rectangular.

(12) The depth of the drop panel shall be determined by computing it as a beam, using the negative moment over the column capital specified elsewhere in this ruling.

(13) In no case, however, shall the dimensions of the drop panel be less than required for punching shear along its perimeter, using the allowable unit shearing stresses specified below.

Shearing Stresses

(14) The allowable unit punching shear on the perimeter of the column capital shall be $^5/_{36}$ of the ultimate compressive strength of the concrete as given in section 533 of the building ordinance. The allowable unit shear on the perimeter of the drop panel shall be 0.03 of the ultimate compressive strength of the concrete. In computing shearing stress for the purpose of determining the resistance to diagonal tension the method specified by the ordinance shall be used.

Panel Strips

(15) For the purpose of establishing the bending moments and the resisting moments of a square panel, the panel shall be divided into strips known as strip A and strip B. Strip A shall include the reinforcement and slab in a width extending from the center line of the columns for a distance each side of this center line equal to one-quarter of the panel length. Strip B shall include the reinforcement and slab in the half width remaining in the center of the panel. At right angles to these strips, the panel shall be divided into similar strips A and B, having the same widths and relations to the center line of the columns as the above strips. These strips shall be for designing purposes only, and are not intended as the boundary lines of any bands of steel used.

(16) These strips shall apply to the system of reinforcement in which the reinforcing bars are placed parallel and at right angles to the center line of the columns, hereinafter known as the two-way system, and also to the system of reinforcement in which the reinforcing bars are placed parallel, at right angles to and diagonal to the center line of the columns hereinafter known as the four-way system.

(17) Any other system of reinforcement in which the reinforcing bars are placed in circular, concentric rings and radial bars, or systems with steel rods arranged in any manner whatsoever, shall comply with the requirements of either the two-way or the four-way system herein specified.

Bending Moment Coefficients, Interior Panel, Two-Way System

(18) In panels where standard drops and column capitals are used as above specified, the negative bending moment, taken at a cross-section of each strip A at the edge of the column capital or over it, shall be taken as $WL/30$.

(19) The positive bending moment taken at a cross-section of each strip A midway between column centers shall be taken as $WL/60$.

(20) The positive bending moment taken at a cross-section of each strip B in the middle of the panel shall be taken as $WL/120$.

(21) The negative bending moment taken at a cross-section of each strip B on the center line of the columns shall be taken as $WL/120$.

(22) In the formulas hereinabove given W = total live and dead load on the whole panel in pounds, L = panel length, c. to c. of columns.

Bending Moment Coefficients, Interior Panel, Four-Way System

(23) In panels where standard drops and column capitals are used as above specified, the negative bending moment, taken at a cross-section of each strip A at the edge of column capital or over it, shall be taken as $WL/30$.

(24) The positive bending moment taken at a cross-section of each strip A, midway between column centers, shall be taken as $WL/80$.

(25) The positive bending moment, taken at a cross-section of each strip B, taken in the middle of the panel, shall be taken as $WL/120$.

(26) The negative bending moment, taken at a cross-section of each strip B on the center line of the columns, shall be taken as $WL/120$.

Bending Moment Coefficients, Wall Panels

(27) Where wall panels with standard drops and capitals

are carried by columns and girders built in walls, as in skeleton construction, the same coefficients shall be used as for an interior panel, except as follows: The positive bending moments on strips *A* and *B* midway between wall and first line of columns shall be increased 25 per cent.

(28) Where wall panels are carried on new brick walls, these shall be laid in portland cement mortar and shall be stiffened with pilasters as follows: If a 16-in. wall is used, it shall have a 4-in. pilaster. If a 12-in. wall is used, it shall have an 8-in. pilaster. The length of pilasters shall be not less than the diameter of the column, nor less than one-eighth of the distance between pilasters. The pilasters shall be located opposite the columns as nearly as practicable, and shall be corbeled out 4 in. at the top, starting at the level of the base of the column capital. Not less than 8-in. bearing shall be provided for the slab, the full length of wall.

The coefficients of bending moments required for these panels shall be the same as those for the interior panels except as provided herewith: The positive bending moments on strips *A* and *B* midway between the wall and first line of columns shall be increased 50 per cent.

(29) Where wall panels are supported on old brick walls, there shall be columns with standard drops and capitals built against the wall, which shall be tied to the same in an approved manner, and at least an 8-in. bearing provided for the slab, the full length. Where this is impracticable, there shall be built a beam on the underside of slab adjacent to the wall between columns, strong enough to carry 25% of the panel load.

The coefficients of bending moments for the two cases of slab support herein described shall be the same as those specified in Sec. 27 and Sec. 28 for skeleton and wall bearing condition, respectively.

(30) Nothing specified above shall be construed as applying to a case of slabs merely resting on walls or ledges, without any condition of restraint. These shall be figured as in ordinary beam-and-girder construction specified in the ordinances.

Bending Moment Coefficients, Wall and Interior Columns

(31) Wall columns in skeleton construction shall be designed to resist a bending moment of $WL/60$ at floors and $WL/30$ at roof. The amount of steel required for this moment shall be independent of that required to carry the direct load. It shall be placed as near the surfaces of the column as practicable on the tension sides, and the rods shall be continuous in crossing from one side to another. The length of rods below the base of the capital and above the floor line shall be sufficient to develop their strength through bond, but not less than 40 diameters, nor less than one-third the clear height between the floor line and the base of the column capital.

(32) The interior columns must be analyzed for the worst condition of unbalanced loading. It is the intention of this ruling to cover ordinary cases of eccentric loads on the columns by the requirement of Sec. 5. Where the minimum size of column therein specified is found insufficient, however, the effect of the resulting bending moment shall be properly divided between the adjoining slab and the columns above and below according to best principles of engineering, and the columns enlarged sufficiently to carry the load safely.

Bending Moment Coefficients, Panels Without Drops, or Capitals, or Both

(33) In square panels where no column capital or no depressions are used, the sum total of positive and negative bending moments shall be equal to that computed by the following formula:

$$B.M. = (WL/8)\ (1.53 - 4k + 4.18k^2)$$

where

$B.M.$ = Numerical sum of positive and negative bending moments, regardless of algebraic signs;
W = Total live and dead load on the whole panel;
L = Length of side of a square panel, c. to c. of columns;
k = Ratio of the radius of the column or column capital to panel length, L.

This total bending moment shall be divided betweeen the positive and the negative moments in the same proportion as in the typical square panels for two-way or four-way systems specified above for interior and wall panels respectively.

Point of Inflection

(34) For the purpose of making the calculations of the bending moment at the sections away from the column capital, the point of inflection shall be considered as being one-quarter the distance c. to c. of columns, both crosswise and diagonally, from the center of the column.

Tensile Stress in Steel and Compressive Stress in Concrete

(35) The tensile stress in steel and the compressive stress in the concrete to resist the bending moment shall be calculated on the basis of the reinforcement and slab in the width included in a given strip, and according to the assumptions and requirements given in sections 532-535 inclusive of the building ordinance. The steel shall be considered as being concentrated at the center of gravity of all the bands of steel in a given strip.

(36) For the four-way system of reinforcement the amount of steel to resist the negative bending moment over the support in each strip *A* shall be taken as the sum of the areas of steel in one cross band and one diagonal band. The amount of steel to resist the positive bending moment of each strip *B* shall be considered as the area of the steel in a diagonal band. The amount of steel to resist the positive bending moment in each strip *A* shall be considered as the area of the steel in a cross band, and the amount of steel to resist the negative moment in each strip *B* shall be the steel included in the width of strip *B*.

(37) For the two-way system of reinforcement the amount of steel to resist the bending moment in any strip shall be considered as the area of steel included in the width of the strip.

(38) In both systems of reinforcement the compresssive stress in the concrete in any strip shall be calculated by taking the area of steel considered for each strip and applying it in a beam formula based on the principles of section 535 of the building ordinance.

(39) Where drop panels are used, the width of beam assumed to resist the compressive stresses over the column capital shall be the width of the drop.

(40) The width of beam, where no drop panels are used, shall be the width of steel bands. Where this is found insufficient, the area shall be increased by introducing compression steel in the bottom of slab.

Rectangular Panels

(41) When the length of panel in either two-way or four-way system does not exceed the breadth by more than 5%, all computations shall be based on a square panel whose side equals the mean of the length and breadth, and the steel equally distributed among the strips according to the coefficients above specified.

(42) In no rectangular panel shall the length exceed the breadth by more than one-third of the latter.

Rectangular Panels, Four-Way System

(43) In the four-way system of reinforcement, where length exceeds breadth by more than 5%, the amount of steel required in strip *A*, long direction, both positive and negative, shall be the same as that required for the same strip in a square panel whose length is equal to the long side of the rectangular panel.

(44) The amount of steel, strip *A*, short direction, positive and negative, shall be the same as that required for the same strip in a square panel, whose length is equal to the short side of the rectangular panel.

(45) The amount of steel in strip *B*, positive and negative, shall be the same as that required for similar strip in a square panel whose length is equal to the mean of the long and the short side of the rectangular panel.

(46) In no case shall the amount of steel in the short side be less than two-thirds of that required for the long side.

Rectangular Panels, Two-Way System

(47) In the two-way system of reinforcement the amount of steel required for the positive and the negative moment of each strip *A* shall be determined in the same manner as indicated for the four-way system above.

(48) The amount of steel in strip *B*, positive and negative, running in short direction, shall be equal to that required for the same strip in a square panel whose length equals the long side of the rectangular panel.

(49) The amount of steel in strip *B*, long direction, positive and negative, shall be equal to that required for the same strip in a square panel, whose length equals the short side of the rectangular panel.

(50) In no case shall the amount of steel in strip *B*, long direction, be less than two-thirds of that in the short direction.

Walls and Openings

(51) Girders and beams shall be constructed under walls, around openings and to carry concentrated loads.

REQUIREMENTS OF DIFFERENT BUILDING REGULATIONS AND AUTHORITIES REGARDING GIRDERLESS CONCRETE FLOOR CONSTRUCTION

For Typical Interior—Square Panel Only

Name of City or Authority	Min. Size of Col.	Slab Thickness	Column Capital	Drop Panel	Bend. Mom. Coefficients 2-Way System Strip A +	Strip A −	Strip B +	Strip B −	Bend. Mom. Coefficients 4-Way System Strip A +	Strip A −	Strip B +	Strip B −	Σ B. M. Pos. and Neg. Per Panel 2-Way	Σ B. M. Pos. and Neg. Per Panel 4-Way	Ratio of Pos. : Neg. B.M. 2-Way	Ratio of Pos. : Neg. B.M. 4-Way	Theoretical† Total B.M.	Bend Mo. on Wall-Col.
Joint Committee		$\frac{L}{32}$ or $\frac{W\frac{1}{2}}{50}$ + 1″ but not less than 6″	$\frac{L}{5}$	$\frac{L}{2.5}$	$\frac{WL}{55.5}$	$\frac{WL}{25}$	$\frac{WL}{133}$	$\frac{WL}{100}$	$\frac{WL}{55.5}$	$\frac{WL}{25}$	$\frac{WL}{133}$	$\frac{WL}{100}$	$\frac{WL}{6.62}$	$\frac{WL}{6.62}$	1:2	1:2	$\frac{WL}{7.05}$	
Am. Concrete Inst.		$\frac{L}{32}$ or $\frac{W\frac{1}{2}}{50}$ + 1″ but not less than 6″	$\frac{L^*}{5}$	$\frac{L}{3.33}$	$\frac{WL}{82.2}$	$\frac{WL}{29.6}$	$\frac{WL}{123}$	$\frac{WL}{148}$	$\frac{WL}{82.2}$	$\frac{WL}{29.6}$	$\frac{WL}{123}$	$\frac{WL}{148}$	$\frac{WL}{8.2}$	$\frac{WL}{8.2}$	1:2	1:2	$\frac{WL}{7.05}$	
Taylor & Thompson		$\frac{L}{34}$ or $\frac{W\frac{1}{2}}{43.5}$	$\frac{L}{4.44}$	$\frac{L}{2.5}$	$\frac{WL}{69.3}$	$\frac{WL}{27.7}$	$\frac{WL}{104}$	$\frac{WL}{157}$	$\frac{WL}{69.3}$	$\frac{WL}{27.7}$	$\frac{WL}{104}$	$\frac{WL}{157}$	$\frac{WL}{7.53}$	$\frac{WL}{7.53}$	1:1½	1:1½	$\frac{WL}{7.36}$	
Indianapolis		$\frac{L}{30}$	$\frac{L}{4.44}$	.....	$\frac{WL}{120}$	$\frac{WL}{30}$	$\frac{WL}{120}$	.....	$\frac{WL}{120}$	$\frac{WL}{30}$	$\frac{WL}{120}$	.....	$\frac{WL}{10}$	$\frac{WL}{10}$	1:2	1:2	$\frac{WL}{7.36}$	
Chicago	$\frac{L}{12}$	$\frac{L}{32}$ or $\frac{W\frac{1}{2}}{44}$ but not less than 6″	$\frac{L}{4.44}$	$\frac{L}{3}$	$\frac{WL}{60}$	$\frac{WL}{30}$	$\frac{WL}{120}$	$\frac{WL}{120}$	$\frac{WL}{80}$	$\frac{WL}{30}$	$\frac{WL}{120}$	$\frac{WL}{120}$	$\frac{WL}{7.5}$	$\frac{WL}{8}$	3:5	1:2	$\frac{WL}{7.36}$	$\frac{WL}{60}$
Detroit		$\frac{L}{32}$	$\frac{L}{4.44}$	$\frac{L}{2.67}$	$\frac{WL}{62}$	$\frac{WL}{30.5}$	$\frac{WL}{116}$	$\frac{WL}{116}$	$\frac{WL}{100}$	$\frac{WL}{30}$	$\frac{WL}{100}$	.....	$\frac{WL}{7.6}$	$\frac{WL}{9.4}$	3:5	3:5	$\frac{WL}{7.36}$	
Philadelphia		.....	$\frac{L}{5}$	$\frac{L}{2.63}$	$\frac{WL}{77.5}$	$\frac{WL}{31}$	$\frac{WL}{124}$	$\frac{WL}{124}$	$\frac{WL}{94}$	$\frac{WL}{28.4}$	$\frac{WL}{144}$	$\frac{WL}{155}$	$\frac{WL}{8.15}$	$\frac{WL}{8.43}$	10:19	1:2½	$\frac{WL}{7.05}$	$\frac{WL}{77.5}$
St. Louis	$\frac{L}{15}$	$\frac{L}{32}$ or $\frac{W\frac{1}{2}}{40}$ but not less than 6″	.....	.....	$\frac{WL}{66.7}$	$\frac{WL}{33.3}$	$\frac{WL}{133.3}$	$\frac{WL}{133.3}$	$\frac{WL}{100}$	$\frac{WL}{50}$	$\frac{WL}{100}$	$\frac{WL}{100}$	$\frac{WL}{8.33}$	$\frac{WL}{10}$	3:5	2:3	.....	.....
Pittsburgh		.....	$\frac{L^*}{4.44}$	.....	$\frac{WL}{64}$	$\frac{WL}{29.5}$	$\frac{WL}{64}$	.....	$\frac{WL}{64}$	$\frac{WL}{29.5}$	$\frac{WL}{64}$	.....	$\frac{WL}{7.7}$	$\frac{WL}{7.7}$	10:11	10:11	$\frac{WL}{7.36}$	
Cincinnati	$\frac{L}{12}$	6″ or $\frac{L}{32}$	$\frac{L}{4.44}$	$\frac{L}{3.33}$	$\frac{WL}{60}$	$\frac{WL}{30}$	$\frac{WL}{120}$	$\frac{WL}{120}$	$\frac{WL}{80}$	$\frac{WL}{30}$	$\frac{WL}{120}$	$\frac{WL}{120}$	$\frac{WL}{7.5}$	$\frac{WL}{8}$	3:5	1:2	$\frac{WL}{7.36}$	$\frac{WL}{75}$

* Assumed special case. † According to formula given in ruling.
NOTE:—"W" = Total live and dead load on panel. "L" = Length of square panel, c. to c. of columns.

Spandrel Beams

(52) The spandrel beams or girders shall, in addition to their own weight and the weight of the spandrel wall, be assumed to carry 20% of the wall panel load uniformly distributed upon them.

Placing of Steel

(53) In order that the slab bars shall be maintained in the position shown in the design during the work of pouring the slab, spacers and supports shall be provided satisfactory to the Commissioner of Buildings. All bars shall be secured in place at intersections by wire or other metal fastenings. In no case shall the spacing of the bars exceed 9 in. The steel to resist the negative moment in each strip *B* shall extend one-quarter of the panel length beyond the center line of the columns in both directions.

(54) Splices in bars may be made wherever convenient, but preferably at points of minimum stress. The length of splice beyond the center point, in each direction, shall not be less than 40 diameters of the bars, nor less than 2 ft. The splicing of adjacent bars shall be avoided as far as possible.

(55) Slab bars which are lapped over the column, the sectional area of both being included in the calculations for negative moment, shall extend not less than 0.25 of the panel length for cross bands and 0.35 of the panel length for diagonal bands, beyond the column center.

Computations

(56) Complete computations of interior and wall panels and such other portions of the building as may be required by the Commissioner of Buildings shall be left in the office of the Commissioner of Buildings when plans are presented for approval.

Test of Workmanship

(57) The Commissioner of Buildings or his representative may choose any two adjacent panels in the building for the purpose of ascertaining the character of workmanship. The test shall not be made sooner than the time required for the cement to set thoroughly, nor less than six weeks after the concrete had been poured.

(58) All deflections under test load shall be taken at the center of the slab, and shall be measured from the normal unloaded position of the slab. The two panels selected shall be uniformly loaded over their entire area with a load equal to the dead load plus twice the live load, thus obtaining twice the total design load. The load shall remain in place not less than 24 hours. If the total deflection in the center of the panel under the test load does not exceed $^1/_{300}$ of the panel length, the slab may be placarded to carry the full design live load. If it exceeds this amount of deflection, and recovers not less than 80% of the total deflection within seven days after the load is removed, the slab may be placarded to carry the full design live load. If the deflection exceeds the allowable amount above specified, and the recovery is less than 80% in seven days after the removal of the test load, other tests shall be made on the same or other panels, the results of which will determine the amount of live load the slabs will be permitted to carry.

General

(59) The design and the execution of the work shall conform to the general provisions and the spirit of the Chicago Building Ordinances in points not covered by this Ruling and to the best engineering practice in general.

Enforcement

(60) This Ruling shall go into effect on and after Jan. 1, 1918. All previous rulings on flat slabs are hereby rescinded.

Why the Chicago Flat-Slab Ruling Was Revised

BY JOHN KRIPPNER

Bridge and Structural Engineer, Department of Buildings, City of Chicago

THIS revised flat-slab ruling for the city of Chicago has been issued with the intention of making it more general in scope, more simple and more accessible to the engineers less familiar with this kind of construction, as well as with a view to improving on some of the details and remedying minor omissions to which attention has been drawn.

It has been thought advisable to express the bending moments in terms of *W*, the total live and dead load on the panel in pounds, and *L*, the length of a side of a square panel, in feet, as these two terms are mostly used in the design.

The old formula for the thickness of slab, $t = 0.023L\sqrt{w}$ has been retained, though somewhat changed for the following reason: In the new formula, $t = W^{\frac{1}{2}}/44$, in which $W = wL^2$ of the old, which upon eliminating w and L, takes on the new form, which is more readily applied. The formula, though empirical, is based upon actual experience and has given satisfactory results heretofore, as attested by a large number of load tests upon finished structures.

The minimum length of drop panel is specified as $L/3$, which is based upon a line of reasoning, shown in Fig. 2, which with a parabolic distribution of bending moment due to uniform load assumes that the drop must extend to the point where the bending moment is

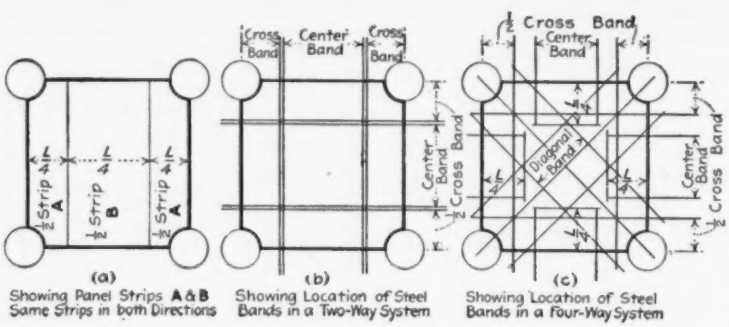


FIG. 1. DISTRIBUTION OF PANELS FOR CHICAGO METHOD OF COMPUTING FLAT SLABS

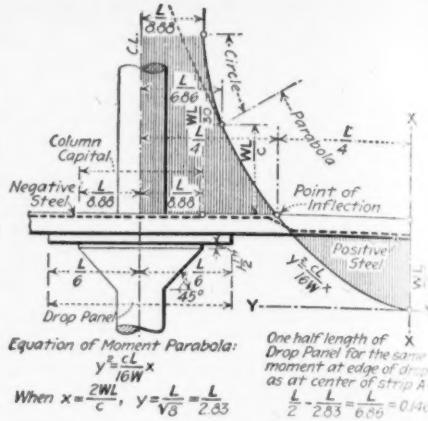


FIG. 2. BENDING MOMENTS IN TYPICAL FLAT-SLAB PANEL

opposite in sign but equal to the bending moment at the middle of the slab, which is the maximum moment for which the slab is designed. This condition gives the theoretical length of drop as $0.292L$. For the most common live loads used, up to 300 lb. per sq.ft., the specified length will be found sufficient, but for heavier loads the punching shear stresses will be found to govern.

The depth of the drop is altogether dependent upon the shearing stresses at the edge of the capital and upon the beam action of the slab, as well as the requirements of light and clearance, which will vary according to the judgment of the designers.

In Fig. 1a are shown the panel strips *A* and *B* into which the standard panel is divided for the purpose of establishing the various bending moments on the panel. Figs. 1b and 1c indicate the location of steel bands designed to resist these bending moments.

The derivation of the general formula for the total bending moment to be used in designing the panels without drops or capitals is based upon a method discussed in *Engineering Record*, June 27, 1914, p. 731; July 25, 1914, p. 116, and Aug. 21, 1914, p. 258.

For the present use two calculus derivations have reached the same concluding formula. In one the total moment is derived by a summation of the moments of differential triangles extending out from the column center; in the other by a summation of the moments of concentric rings in the same panel.

While this formula is based upon purely statical methods of slab analysis, it gives the maximum possible sum of the applied bending moments acting upon a square panel. The distribution of this total between the positive and the negative moments resisting the applied moments depends, more or less, upon the rigidity of the slab and the column capital, as well as upon the interaction of the elementary particles in the slab, the sum of all of which together may be less, but cannot exceed the limit given by the formula. It has been thought sufficiently accurate to specify this distribution of positive and negative moments in the ratio of 1:2 and 3:5 in the four-way and the two-way types, respectively, a conclusion which is well borne out by theory as well as practice.

In the accompanying table is given a comparison of the various requirements of different authorities and building codes as regards the flat-slab construction, and it is interesting to note how the results, which have been obtained by more or less independent investigations, agree with the Chicago ruling and the theory of flat slab herein given. Minneapolis uses the old Chicago Ruling; Baltimore, the same as Philadelphia and Washington and Boston, the same as the Joint Committee. Other interesting conclusions may be drawn from the study of this table, one being the fact that the Joint Committee report recommends a sum of bending moments which is greater than that given by the theoretical formula.

Fig. 3 shows a tentative arrangement of steel required to resist the applied bending moment upon the wall column at roof and floor line. The bending moment on wall column has been specified $WL/60$ so as to balance the negative moment on strip *A*, which equals $WL/30$ on an interior panel. Since this moment must be resisted by one column above and one below the floor

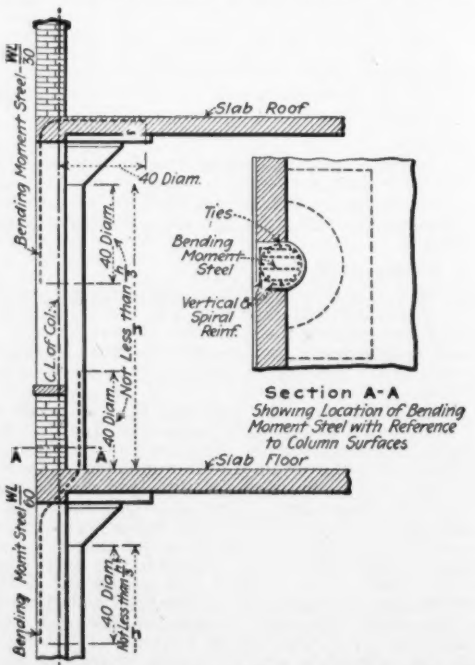


FIG. 3. LOCATION AND LENGTH OF REINFORCEMENT ON WALL COLUMNS BY CHICAGO RULING

line, the moment on each will be only one-half the total. For similar reasons the applied moment on roof column will be $WL/30$, as there is only one column to resist it.

As regards the distribution of bending moments in rectangular panels the principle of the inverse ratio of the cubes of the lengths has been adhered to. For, as in the old ruling it was specified that computations be based on an assumed square panel whose length of side is equal to the mean length and breadth of the rectangular panel, and further that the amount of steel thus found for strip A, long direction, be multiplied by the cube of the ratio of the long side of the rectangular panel to the side of assumed square panel, the same result is obtained as follows:

Let w = Dead and live load per square foot.
L_l = Long side of the rectangular panel.
L_s = Short side of the rectangular panel.
W_l = Total load on a square panel, whose side equals L_l.

Then the bending moment on strip A of the assumed square panel is equal to

$$M_{SA} = w\left(\frac{L_l + L_s}{2}\right)^3 \times c$$

where c = a constant. Now, in order to get the moment on the long strip A of the rectangular panel, this moment must be multiplied by

$$\left(\frac{L_l}{\frac{L_l + L_s}{2}}\right)^3, \text{ or } M_{RA} = wL_l{}^3c$$

But since $W_l = wL_l{}^2$, $M_{RA} = W_lL_lc$, that is, the required moment, and consequently the area of steel, is the same as though the strip were located in a square panel whose side equals that of the long side of the rectangular panel.

In a similar way it may be shown that the area of steel required for short strip A is the same as though the strip were situated in a square panel, whose side equals the short side of the rectangular panel.

As regards the increase of bending moments in wall panels, it has been thought sufficient to increase only the positive moments on strips running toward the wall or wall girder, as the bending moment now being required on wall columns will tend to offset the effect of the unbalanced loading on the negative moments. The moments on wall panels resting on walls have been specified larger than on those of skeleton construction, so as to offset the difference in the restraint upon the slab, for it was generally found in tests that wall panels merely supported on walls had a greater deflection than those monolithic with spandrel beams and columns and that both had larger deflections than the interior panels.

In general, the new ruling combines the experience of the past four years, during which period buildings and other structures were built according to the old ruling and all of which passed the load test more or less satisfactorily. In order to gain an idea of the importance of flat-slab type of construction in this city, suffice it to say that in 1916 alone there were 24 flat-slab buildings completed, representing about 39% of the value of concrete buildings of all types and about 3.9% of the aggregate value of all buildings built in that year.

Interurban Line Hauls Material for Concrete Road

Cars Spotted Along Work for Unloading—Different Aggregates Used in Two-Course Paving—Grader Scrapes Concrete

NO RAILWAY equipment was tied up last summer in hauling aggregate for the 5-mile Belleville portion of the 10-mile boulevard connecting that city with East St. Louis, Ill. A double-track electric interurban line occupying the 21-ft. central space of the 60-ft. road was utilized to deliver the materials, which were shoveled from the cars directly onto the subgrade.

Two concrete roadways with a double-track electric interurban railway between them is the arrangement adopted for this boulevard. Each roadway has a curb on the outer side, but no sidewalks are provided, as the width of the property allowance for sidewalks varies from 2½ ft. to 20 ft. The separation of vehicle traffic,

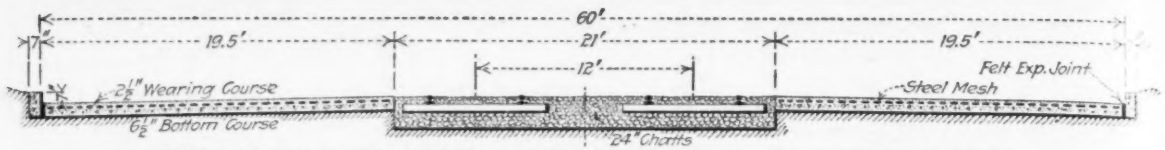
COMPLETED PORTION OF INTERURBAN BOULEVARD HAVING TWO CONCRETE ROADWAYS SEPARATED BY ELECTRIC LINE

however, by the use of two roadways for movements in opposite directions conduces to the safety of pedestrians as well as of vehicles.

After the old roadbed was graded the curbs were built on the subgrade. These are 7 x 16 in., with the top 7 in. above the gutter. The concrete for these was a 1:2½:4 mix, made with ¼-in. to 1¼-in. crushed limestone as the coarse aggregate. The curbs are made with joints 8 ft. apart. The catch-basin castings are of L-shape, with grated openings in the roadway and the face of the curb.

The 9-in. roadway paving is laid in two courses. The 6½-in. bottom course is a 1:2½:4 mix, with crushed limestone graded from ¼- to 1¼-in. The 2½-in. top course is a 1:2¼ mix, the aggregate being composed of a 1 part sand and 2¼ parts crushed red granite of ⅛- to ¾-in. size. On the bottom course are laid sheets of expanded-metal reinforcement. It was specified that the top should be placed not more than 40 min. after the bottom course.

Transverse expansion joints are placed 35 ft. apart, but are kept clear of alleys and cross streets. They are of the Trus-Con type, having a ½-in. strip of tarred felt 9 in. deep secured between a pair of light 2½-in.



CROSS-SECTION OF INTERURBAN BOULEVARD COMBINED WITH ELECTRIC RAILWAY

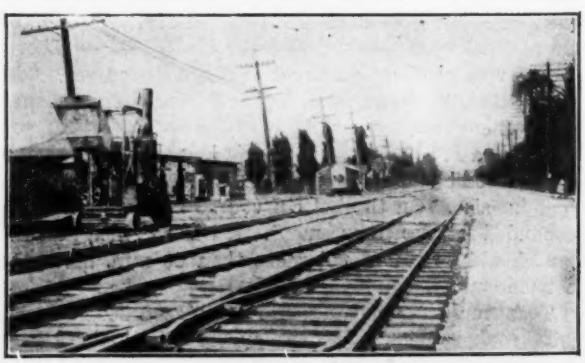
steel channels which are flush with the concrete surface. A longitudinal joint along each curb is formed by a ⅜-in. felt strip 9 in. deep.

One roadway was kept open to traffic while concreting was being done on the other side. The finished concrete was left for two weeks before traffic was allowed upon it, and during this time it was covered with about two inches of clay and earth as a protection against the sun. This covering was applied the day following the concreting and was kept damp. It was afterward removed by means of a road grader and team, with which one man could clean 1500 lin.ft. of 19½-ft. roadway in four hours.

The contractor worked from one to four concreting gangs, which were composed largely of negroes. For the curbing the gang consisted of nine men with a mixer of 7 cu.ft. capacity (wet materials). For the paving, the gang consisted of about 17 to 21 men, with a ½-yd. Koehring mixer, operated by steam. A gang of 17 men could lay 315 ft. of 19½-ft. roadway in nine hours.

Concrete materials were handled in an unusual manner, owing to the existence of the double-track electric interurban line in the middle of the boulevard, and the fact that the railway operates an extensive freight traffic. The stone and sand were delivered in trains of large gondola cars hauled by electric locomotives. A stretch of one track adjacent to the paving about to be done was given up to this work train service, passenger traffic in both directions being handled temporarily on the other track. Temporary crossovers were put in at each end of this section, and car movements on the single track were controlled by operators at each end, with telephone communications and electric lamp signals.

The cars were set out or spotted by the railway at the desired spacing to afford the approximate quantities of concrete material along the work. The unloading was done by hand shoveling. Ballast for the tracks was delivered and unloaded in the same way and then shoveled into place by the railway track gangs.



CONCRETE MIXER IS PLACING THE SECOND 19½-FOOT ROADWAY OF 60-FOOT INTERURBAN BOULEVARD

Between the two 19½-ft. driveways is a 21-ft. space for the electric line. The tracks are spaced 12 ft. c. to c. and are of ordinary construction, with T-rails on cross ties. There is no paving, but the ties are laid on a 24-in. bed of chatts (zinc-tailings), and the same material is filled in between the ties and rails. One special advantage of the material is that it is substantially dustless, even under high-speed cars. At street intersections, brick paving is laid across the track space for a width of 25 feet.

This arrangement is very convenient for the railway. It is inexpensive and requires no special construction, and it enables surfacing and track-repair work to be done without interfering with paving or street traffic. It also permits the putting in of crossovers as they are required.

This work in Belleville is known as the West Main Street improvement, and has a length of 5.33 miles within the city limits. It was begun in 1916 and completed in 1917. The paving is paid for by special assessment, and the track work was done by the East St. Louis & Suburban Ry. at its own expense. The contractors for the paving were Reeb Brothers, Belleville. The work was done under the direction of W. C. Wolf, the city engineer, and C. A. Heinzelman, the assistant city engineer.

Somewhat different construction has been adopted for the 3.67 miles within the city limits of East St. Louis. The arrangement of tracks and roadways will be the same, but the paving will be of brick on concrete and two 18-ft. sidewalks will make a total width of 96 ft. The track space is to be left unpaved (except at street intersections) for five years, but crushed stone will be filled in level with the roadways.

The assessments for this work have been confirmed by the court, but during the time occupied by the legal proceedings the prices of materials have increased to such an extent that the cost will be far in excess of the estimate. As the assessments will not cover the increased cost, the construction is necessarily postponed. This part of the work is under the direction of E. E. Harper, city engineer of East St. Louis.

Illinois Cities Favor Waterways

Representatives of 33 Illinois cities at a Waterway Conference held in Peoria, Nov. 27, adopted a resolution in favor of completing a navigable waterway between Lake Michigan and the Illinois River. The resolution favored the plan provided for in the act passed by the legislature in July, 1915, and urged the enforcement of this law, as consideration of other plans at this time would require new legislation and further action by the War Department. Governor Lowden was requested to ask the U. S. Government to coöperate by improving that part of the waterway over which it has jurisdiction.

Camp Warehouses Are Largely of Plank Construction

One-Story Five-Acre Timber Buildings with Concrete Floors Have Driveways and Railway Tracks—Tanks and Sprinklers for Fire Protection

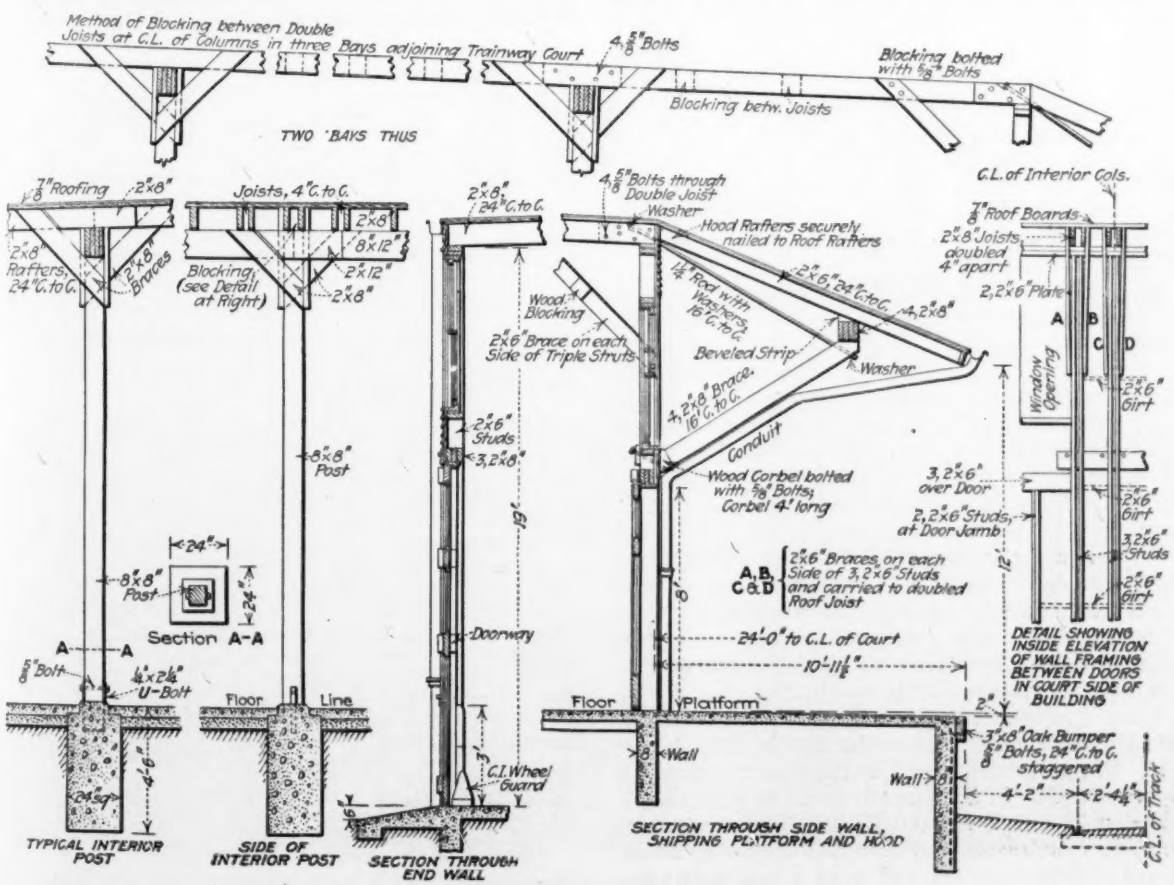
BUILT-UP structural members are used extensively in the frame warehouses at the U. S. Signal Corps camp near Middletown, Penn., which are typical of similar structures to be built at several other army camps. The reason for using such members in place of solid timbers is the greater ease and rapidity of assembling and erection.

The building is a one-story structure, U-shaped in plan, 832 ft. long over all. The two legs or sheds are each 112 ft. wide and are connected at one end by a structure of the same width. The height of each shed is 16 ft. at the sides and 18 ft. at the center. In the 48-ft. court are two stub-tracks spaced 13 ft. c. to c. and two 11-ft. platforms, the latter connected at the inner end. The floors and platforms are of concrete, and concrete walls extending to the floor level carry the outer walls of the building. The interior columns rest upon concrete pedestals.

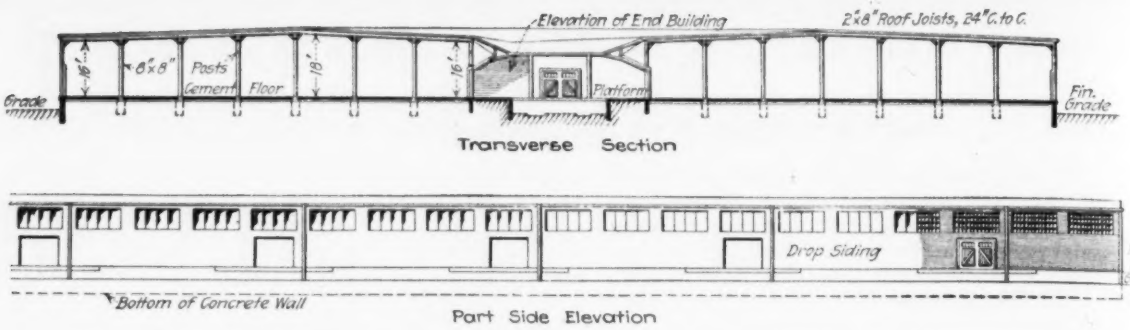
Plank construction is used almost exclusively, beams and other large members being built up of planks, and the posts being the only large solid timbers. The posts, spaced 16 ft. in both directions, are 8 x 8 in. except that those in the end walls are 6 x 8 in. These carry longitudinal girders 8 x 12 in., built up of four 2-in. planks, and formed in lengths of 16 ft. Across these are the plank rafters or roof joists, spaced 2 ft. c. to c.; these are doubled over the posts. Upon the rafters is the sheathing of 1-in. plank, laid longitudinally and covered with composition roofing.

Rigidity of the structure is insured by securely attaching the posts to the foundations and the roof framing. Each post is anchored to its pedestal by a U-shaped stirrup, having its sides bolted to the post and its lower portion embedded in the concrete. At the head of the post, kneebraces are provided in both directions, two braces connecting the post with the longitudinal girder and the others connecting it with the transverse roof joists. Single kneebraces at 16-ft. spacing connect the wall posts with the rafters. Additional kneebraces are used along the walls next to the railway siding to resist the thrust of the canopy roof over the loading platforms. The studs in this side wall and the roof joists in the first bay on this side are doubled for the same purpose.

The canopy roof is carried by inclined braces framed against corbels on the wall posts, and each having its



THIS CAMP WAREHOUSE IS MAINLY OF PLANK CONSTRUCTION



STRUCTURAL DETAILS OF TIMBER WAREHOUSE FOR ARMY CAMPS

outer end held by a tie-rod anchored to the double joists of the roof. Upon these braces rests a longitudinal girder built up of four 2 x 8-in. planks, and having a wedge-shaped strip to support the ends of the rafters. These are spaced 24 in. c. to c., and have their upper ends spiked to the roof rafters. The canopy has a sheathing of 1-in. plank covered with composition roofing.

The walls have studding of pairs of planks, spaced 24 in. c. to c., and carrying a wall-plate upon which the roof rafters rest. The studs on either side of each doorway carry a built-up lintel. The outer covering is a single course of drop siding spiked to the studs.

Doorways 10 x 8 ft., spaced 32 ft. and 64 ft. c. to c. are placed in the side walls. These are fitted with sliding doors carried by barn-door hangers running on a bar attached to the inside of the lintel. Between and over the doorways there are large window openings. The upper windows have stationary sash, but with one pivoted sash in each bay for ventilation. The pivoted sash are connected and operated in groups. The door transoms are pivoted. For the offices, the windows have vertically sliding sash and are covered with wire screens. The exterior of the walls is given two coats of paint.

Around the building extends a 40-ft. concrete driveway, having a high wire-mesh fence on the outer side. The fencing is attached to 3½-in. iron posts, 10 ft. apart, and triangular caps on these carry lines of barbed wire forming a ridge that effectually prevents fence climbing. Entrances to the driveways and track space are fitted with steel-frame gates covered with wire mesh and topped with barbed wire. The driveway is dished or concave, and drains to cesspools having sewer connections.

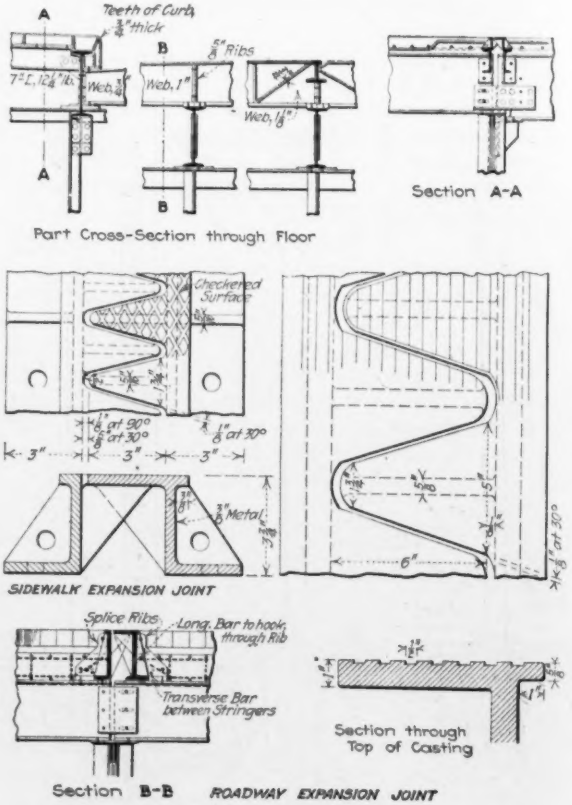
For fire protection the Middletown warehouse has a 75,000-gal. steel tank on a 75-ft. tower, with an 8-in. connection to the city water mains. An 8-in. main extends under each side driveway, the two being connected by cross-lines of the same size. Laterals of 6-in. pipe serve hydrants inside the building.

Yellow-pine is used for these warehouses, and the assumed maximum fiber stress for this is 1800 lb. per sq.in. The assumed live-load on the roof and canopy is 25 lb. per sq.ft. In the hangars at the aviation camps, provision is made for suspending the aëroplanes from the 65-ft. roof trusses, described in *Engineering News-Record* of Sept. 6, p. 447, and in such case the trusses are designed to carry an additional load of 2000 pounds.

These warehouse buildings were designed by Albert Kahn, architect, Detroit, and the plans were made so complete as to framing and details that they furnished sufficient information for the cutting and assembling of the lumber. The warehouses at Middletown were built under the direction of R. H. Hinman, construction superintendent for the U. S. Signal Corps. The contractor was James L. Stuart, Pittsburgh. It required about 60 days to erect the buildings complete.

Successful Roadway Expansion Joint on Cleveland Bridges

THE numerous troubles experienced with roadway expansion joints on bridges have been eliminated on some of the city bridges of Cleveland, Ohio, by the



SAWTOOTH EXPANSION JOINT USED ON CLARK AVENUE VIADUCT, CLEVELAND

use of a non-overlapping expansion joint in which the gap at the joint is of sawtooth form. It is illustrated in the accompanying drawing. The body of each half of the joint is a ribbed pavement-curb casting having the full depth of the pavement—in the case shown 15 in. A triangular rib supports each one of the sawteeth. The upper surface is grooved transversely or—as in the case of the sidewalk joint—is checkered.

This joint gives a roadway surface free from all bumps or gaps. Trouble from dirt packing in the joint is avoided. In a year or more of use of these joints on the Clark Ave. viaduct there has been no complaint from users, but on the other hand much favorable comment, while the use of other forms of joint on other Cleveland bridges brings frequent complaints from citizens. Although trouble might be expected from occasional breaking of the sawteeth, no case of such breakage has occurred.

This form of joint was designed by F. D. Richards, bridge engineer, and Howard Brocklebank, assistant bridge engineer, of the city of Cleveland. It was first used about two years ago, being applied experimentally on Central Viaduct. Later the new Clark Ave. viaduct was equipped with this joint throughout.

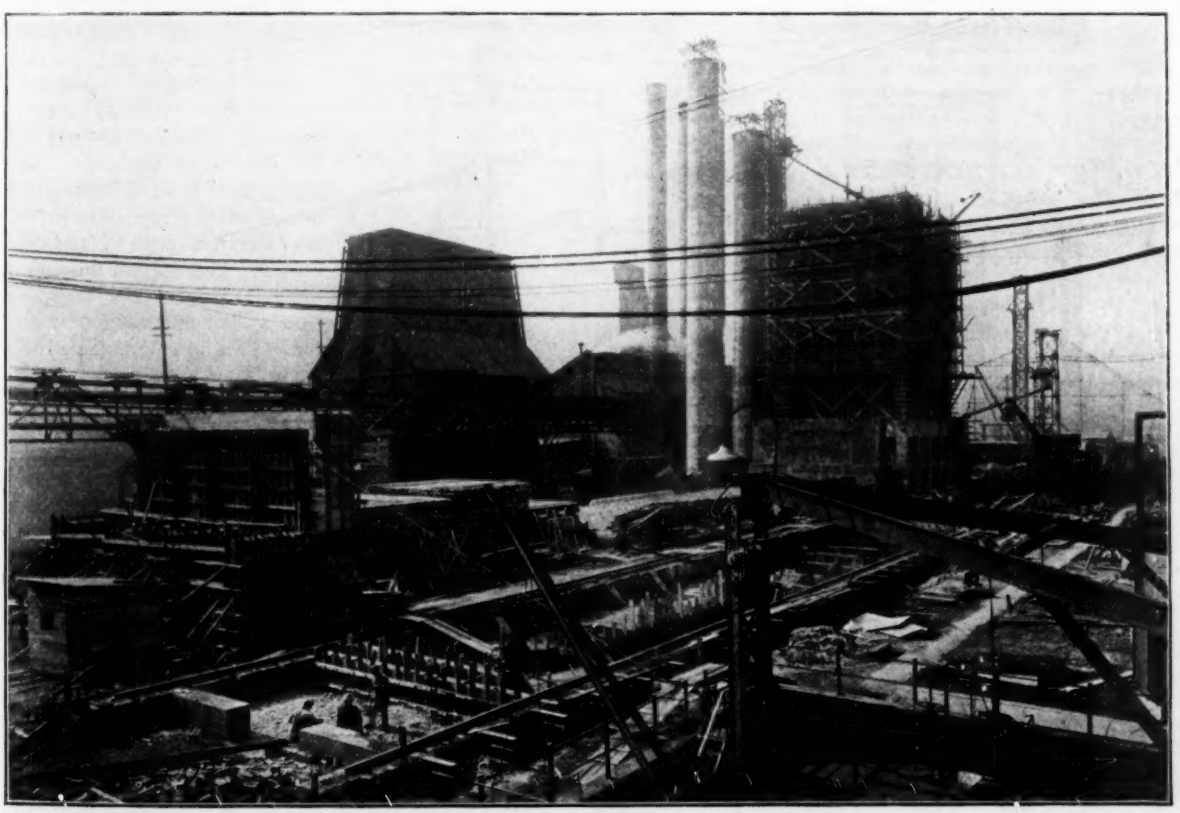
Concrete Coal Bunker Built at New Coke Ovens

Bins Hold 1800 Tons, Finished in 60 Days—Foundation Mat on Piles Five Feet Above Original Ground—Deep Footings for New Plate Mills

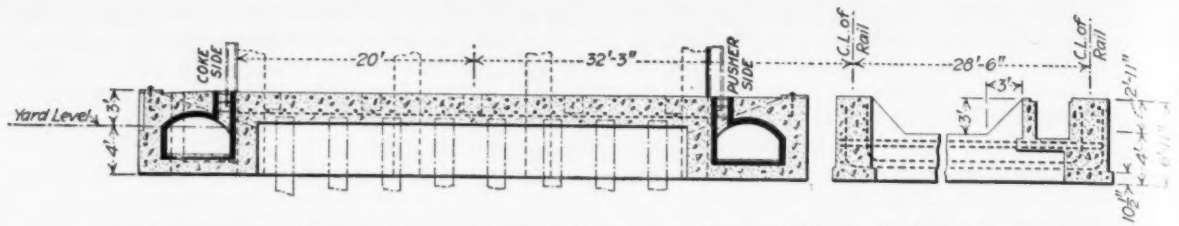
STEEL and other materials were economized in the design of two batteries of Koppers coke ovens being completed at the plant of The Youngstown Sheet & Tube Co., near Youngstown, Ohio. The coal bunker and stacks are of reinforced-concrete construction instead of steel. The company is also constructing a new plate mill, the deep foundations for which are being completed as fast as working drawings for them can be made.

The new coke plant consists of two batteries of 51 ovens each, between which is located the reinforced-concrete coal bunker. This bunker is divided into two bins of 900 tons capacity each, the coal being supplied to these bins by means of an extension of the overhead belt conveyor from the receiving track of the existing ovens. The interior vertical walls of the bins are of concrete, and the slopes at the bottom leading to the discharging hoppers are formed by a slag-concrete fill upon which is placed a layer of ½-in. ribbed wire glass bedded in plaster of paris. The general design of the coal bunker is shown in the accompanying plans and sections.

On the south side of the bunker a pair of stacks, one for each battery of ovens, is being erected. These stacks



BINS ARE IN CENTER OF OVEN STRUCTURE—TOWER BEHIND TRACK CONCRETE PLANT AT RIGHT PLACED ALL FOUNDATION CONCRETE

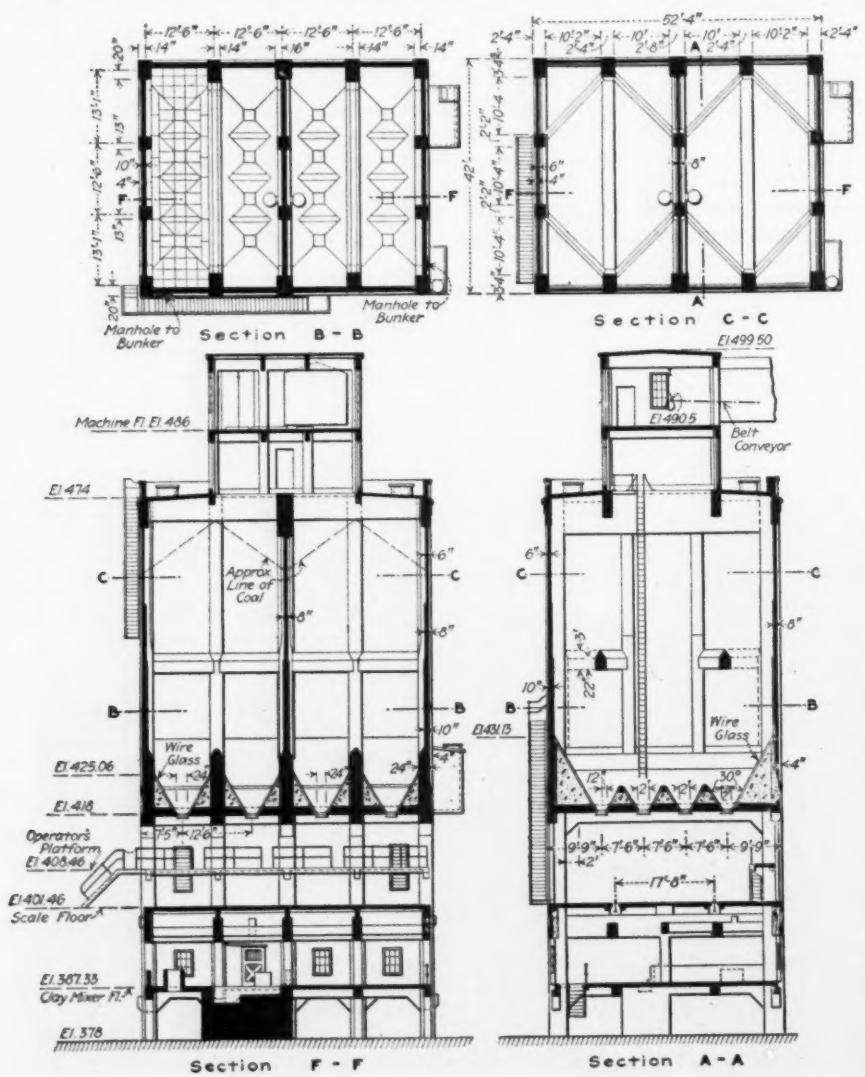


FILL BETWEEN FLUES, MADE AFTER DRIVING PILES, SAVED THICKNESS OF CONCRETE DECK

are 225 ft. high and are constructed of reinforced concrete to avoid the necessity for using steel plates. On this side is also located the quenching track upon which is operated the car for handling the coke immediately after it has been removed from the ovens. On the north side is located the track on which the pusher for shoving the coke from the ovens into the car on the quenching track is operated. This track consists of two rails, each securely anchored to a concrete wall, these walls being tied together by cross reinforced-concrete girders to distribute the thrust of the pusher.

The ground at the site of the ovens had previously been filled in with refuse material, so that it was necessary to drive concrete piles for both the coke oven and coal bunker foundations. In the construction of the coke oven foundations 1500 concrete piles, which averaged 22 ft. in length, were first driven and their tops left 5 ft. above the existing ground level. The bottom and side walls of the gas and air flue tunnels, which run under each side of the oven foundations, were then built, and the space under the oven mat and between the tunnel walls was filled in with granular slag to the top of the piles. After this fill had been allowed to settle for three weeks the 2½-ft.-thick reinforced-concrete oven mat was poured over the entire area under the ovens, the roof of the tunnel being formed in this slab.

For the entire job approximately 9000 yd. of concrete was placed, and 75% of the coarse aggregate used was ¾-in. slag crushed at the steel plant. Sand, slag, gravel and cement were received in carloads on sidings at the site of the ovens and the sand, slag and gravel were unloaded by a locomotive crane and a stiff-leg derrick with clamshell buckets. The derrick unloaded material from cars directly into a slag and sand storage bin. This bin was located at the mixing plant used for the oven and bunker foundations. At the bottom of this bin a hopper holding the proper amount of sand and slag required for each batch of concrete was placed and the material was dumped from this hopper into a skip car which was hauled up an incline track by a cable attached to the second drum of the hoisting engine and dumped automatically into the charging hopper of the mixer. The skip car then returned to the material hopper by gravity. A ¾-yd. steam-driven concrete mixer was used and the hoisting



RIBBED WIRE-GLASS IN BOTTOM OF CONCRETE COAL BUNKER, DESIGNED TO ELIMINATE STRUCTURAL STEEL

tower was 115 ft. high, the concrete being hoisted in a ¾-yd. bucket, dumped into a hopper and from there deposited in place by chutes.

For concreting the pusher track foundations a mixing plant mounted on a flat car was used. This plant consisted of a timber storage bin for slag and sand erected on one end of the car, a 1-yd. concrete mixer mounted on the other end and a steel tower fastened to the end of the car in front of the mixer. The materials were delivered to the bin by a locomotive crane.

At the mixing plant used for the coal bunkers the materials were unloaded from the cars by a locomotive crane into storage piles near the mixer. As the space around this mixer was limited, it was necessary to use wheelbarrows for handling the material between the storage piles and the mixer. A ¾-yd. mixer was used and the concrete was hoisted in a ¾-yd. bucket and placed in the forms by chutes.

Work was started on the ovens on July 14, and by Oct. 6 the foundations for the ovens proper, the coal bin and half of the pusher track had been completed, the work being considerably ahead of schedule. The coal bunker structure was begun Sept. 1 and finished by Nov. 1, in the remarkable time of 60 days. Although progress has exceeded expectations, three weeks were lost during this time by delays in receiving materials.

Building Under Construction

The company has also under construction a large mill and warehouse building, which will accommodate two plate mills. The mills themselves are situated in the center of the main building, the warehouse being at a right angle across the west end of the mill building. The entire structure requires 1800 concrete piles, of which 400 are under the mills. Except at this point, where the ground was excavated to a depth of 16 ft. below the original surface and 4000 yd. of concrete placed in foundations for the mills, a fill of 10 ft. of granulated slag was made over the entire site. Two piledrivers were used in placing the 1800 piles mentioned, one of which drove all those on the east end of the main building and then was carried down into the pit on an incline and used to complete the piledriving for the mill foundations. The other rig drove the west end of the main building and the piles for the warehouse building. The piledriving was started Aug. 15, as soon as possible after the decision to construct the mill was reached. A track concrete plant, without a tower, is being used to pour directly the footings on the south side of the structure, while a stationary mixer on the north side has placed the concrete in the lower part of the footings for the mills. This concrete was placed by spouting to a side-gate hopper on the floor of the excavation and wheeling the concrete to the place in buggies. A 150-ft. tower, however, has been erected on the north side of the structure near the center, and will be used to distribute concrete over the entire middle third of the mill building.

Because of the speed with which work was started after a decision to build had been reached, it was necessary to place the footings for the building itself first, and then, after this had been designed, to go back and put in the piers for the machinery to be installed.

The construction work is being carried out by Stone & Webster, for whom George Chamberlin is superintendent of work in the Youngstown district. The piles were driven by the Raymond Concrete Pile Co. The concrete stacks for the coke ovens are being built by The Rust Engineering Co., which also designed them. The coke plant has been designed by The H. Koppers Co., with the exception of the coal bins, designed by Stone & Webster. The design of the plate mills and supervision of construction are in charge of the engineering force of the Youngstown Sheet & Tube Company.

Minnesota Plans $7,500,000 Road Work for 1918

State-Aid and Federal-Aid Funds to 86 Counties—Hard Surface to Replace Gravel on Main Roads

GREATER attention to road maintenance, increasing use of machinery in road construction, growth of motor-truck and automobile traffic, and the consequent necessity of hard paving instead of graveling for the main roads, are important points touched upon in an advance copy of the report of the Minnesota State Highway Department.

Construction and maintenance of state-aid roads during 1917 cost about $4,430,000, and it is estimated that about 75% of the state-aid work contemplated last spring will have been completed by the end of the year. The three counties of Hennepin, Ramsey and St. Louis, in which are the three principal cities, St. Paul, Minneapolis and Duluth, are not included in the jurisdiction of the department, and the expenditures in these are estimated at about $1,200,000. For the remainder of the state the cost for state-aid road construction is classified as follows: 1166 miles of grading to final grade, $1,646,777; 344 miles of graveling, $527,136; 202 bridges, $605,000. In addition, the maintenance of 11,000 miles cost approximately $450,000, or an average of $41 per mile. The funds available for all the work in the State in 1917 included $3,237,300 from county road and bridge levies, and $1,432,150 for state-aid allotments. From the total must be deducted $1,169,450 for the three counties noted, leaving a net total of $3,500,000 for work under the direction of the State Highway Department.

For the state-aid road construction and maintenance work in 1918 there is available the approximate amount of $7,520,000, made up as follows:

Country road and bridge levies	$4,167,900
State-aid allotments (estimated)	2,000,000
Federal-aid allotments for 1917	142,398
Federal-aid allotments for 1918	284,738
Federal-aid allotments for 1919	425,865
Special hires for federal-aid work (estimated)	500,000
Total	$7,520,947

Prospective Road Work

Carrying on road improvement work in 1917 has been a rather difficult problem, the labor situation being very uncertain and material not only of high cost but difficult to obtain. This year's experience indicates the necessity for more intensive maintenance and for a greater use of machinery in construction work. The latter will necessitate changes in layout of construction plans, and in the end will result in lower cost of work. It is thought that the present condition therefore may advance road building, by leading to more efficient and economical methods of handling the work.

Road maintenance, however, is the important problem, and even if road building should be restricted, an intensive system of maintenance would result in better road conditions. For this reason the Highway Department will devote particular attention to that branch of the work during 1918. On both construction and maintenance, this year's work is marked by a much greater use of tractors and other motive power, which has released teams and men for agricultural work. Until recently, the grading and some of the construction work were considered a source of income for the farmers, and the introduction of outside machinery and equipment was somewhat resented, but now it is often the case that farmers will use their equipment on road work solely as an aid to the good-roads movement.

Federal-aid work was not started during 1917, as had been expected, except on the portion of the Twin Cities-Duluth highway through Chicago county. It is expected that with the available funds for next year most of the main lines of travel will be connected with surfaced roads. This includes the completion of the Twin Cities-Duluth highway; the extension of the Jefferson highway to the Iowa state line; the construction of the scenic highway from the Twin Cities to the Cass Lake and Leech Lake region; the National Parks highway connection to Winona and from St. Cloud to Fergus Falls; the Glacier Park highway as far west as Willmar; the Yellowstone Trail to Granite Falls, and the Chicago, Black Hills and Yellowstone Park trail from Winona to the Dakota line. This last will probably be the first complete surfaced road across the state of Minnesota.

A small amount of work in Cook County will give a first-class road from the Twin Cities to Port Arthur, Ontario. It was only this year that the connection was made between the Ontario and the Minnesota portions of this road, so as to open it for traffic. This road has opened up a new recreation district, and similar districts will be opened up by some of the other new routes mentioned.

Tourist, Auto-Bus and Freight Traffic on Roads

Tourist traffic is increasing and is expected to be a large factor in 1918. A week's traffic census taken this year on state road No. 1, Dakota County, which is the main road leading from Iowa to the Twin Cities, showed an average of 1129 automobiles per day. The National Parks highway in Sherburne County averaged 433 per day, while other main roads leading to recreation districts averaged from 250 to 600 automobiles per day. With the contemplated improvement of the main lines it is assumed that the main arterial highways from the south will carry an average of 1000 machines per day, while the main lines to the recreation districts will average about 600 machines per day. A careful count shows an average of 3½ passengers per automobile, which gives an indication of volume of traffic and probable expenditures by tourists.

Interurban auto-bus service is increasing and is a special feature of road development in Minnesota. This is particularly the case in the northern part of the state, where it was not expected that such service would be patronized to any great extent. There are a number of such lines in operation, and one in particular, 160 miles long, runs on a schedule requiring a speed of over 20 miles per hour. Freight haulage by highways has not developed to any great extent, due partly to the fact that main lines of travel have not been connected up. But it is expected that this traffic will come in great volume next year on account of car shortage and congestion of railway traffic.

Building gravel-surfaced roads is the policy which has been adopted and will be carried forward next year, but the State Highway Department considers that in a short time the main lines of highways must be surfaced with a more durable material to withstand the increasing traffic of heavy motor trucks and rapid passenger vehicles.

Road Funds and Road Administration

State-aid funds are distributed to the 86 counties, with not less than 1% nor more than 3% allotted to any one county. This makes a nearly even distribution, for only 14% of the total fund is to be distributed at the discretion of the Board of Apportionment, which is composed of the commissioner of highways, the state auditor and the state treasurer.

Distribution of state-aid paid to the several counties is based upon their valuation. The rate is 80% of the cost of the work for counties having a valuation of less than $5,000,000, 70% for those with a taxable valuation of $5,000,000 and less than $10,000,000, 60% for those over $10,000,000 and not exceeding $15,000,000, and 50% in all other counties.

Additional maintenance funds were provided by the revision of the state-aid road law at the last session of the legislature. Prior to this year, 20% of the state road and bridge fund, with a due proportion of county funds, was to be set aside for the maintenance of state roads. Under the revision a county may have not less than 20% nor more than 30% set aside for this purpose, and the commissioner of highways is given authority to enforce maintenance by doing such work as the counties neglect and charging the cost to the county's state-aid account.

The system of control of the road work was also changed in the above revision. Formerly there was a non-paid State Highway Commission (which met monthly) and also a state engineer. These officers have been abolished, and there is now a Commissioner of Highways who is appointed for a term of six years and takes over the functions of the commission. He is not required to be a technical man, but the law gives him authority to employ a deputy commissioner to take charge of the engineering work. Charles M. Babcock is commissioner of highways, and John H. Mullen is engineer and deputy commissioner. Carl E. Nagel is chief bridge engineer.

Freight Cars Once Junk Help Road Work

While the embargo on the use of open freight cars for hauling material needed for highway construction is hindering work of this kind it is not completely stopping road construction in California. The Board of Supervisors of Tulare County has overcome the difficulty by taking over two hundred freight cars discarded by the Southern Pacific Co. as junk and putting them in shape to transport sand, gravel and other materials needed. Federal officials have sanctioned the use of these cars and most of them are now in use.

Creosoted Block Can Be Laid on Hardened Pitch Cheaper Than on Dry Mortar

If Base Is Proportioned To Provide Slight Excess of Mortar It Can Be Finished with Wood Floats to a Sufficiently Even Surface—Inspection of Block After Laying Is Made with Comparative Ease

By Walter Buehler
Engineer, Wood Preservation and Paving, The Barrett Co., New York

POSSIBLY the general opinion as to the costliness of laying wood block on a pitch layer has arisen from lack of actual experience with this type of construction, and perhaps also because of the erroneous idea that it is necessary to give the concrete base a "side-walk" finish. Furthermore, there has been the opinion that the block had to be set in hot pitch, or that each block must be dipped in pitch before laying. Naturally, details of this nature would work very much toward producing a pavement of excessive cost per square yard; but experience has shown that these details are unnecessary.

In the past, specifications for this construction have called for a mortar bed to be laid on the concrete base and then trowelled to a smooth surface. But it is not necessary that the surface be smooth, although it should be made at least as even as the sand-bed of the more usual constructions. If the specifications for the concrete base are so drawn as to provide for a slight excess of mortar—say a 1:3:5 mix instead of the usual 1:3:6 mix—it will be found perfectly possible and indeed easy to secure a satisfactory surface with wooden floats. After the concrete has hardened the top can be painted with a thin coat of pitch, which should be allowed to harden before the blocks are laid. After the blocks have been placed in position and inspected, they can be rolled with a light tandem-roller, which will be found sufficient to set the blocks in the pitch so that they will adhere firmly to it.

Comparing the cost of this form of construction with that of the dry-mortar cushion specifications, it will be noticed that the cost of evening up the concrete plus the pitch and labor of painting it on the concrete base is offset by the saving of about one inch of grading, due to the elimination of the cushion, plus the cost of sand and cement and the labor of spreading it.

The superiority of the paint-coat over the dry mortar-bed or the usual sand-bed is that the bottom of the block, as well as the sides, are sealed. From a construction viewpoint there are still other advantages. For example, during the period of construction it often happens that a sudden heavy rain will wash out the sand or mortar cushion from under blocks that have not been filled with bitumen. An accident of this sort will necessitate relaying both cushion and block. This cannot occur with the bituminous paint-coat construction. Furthermore, even though a rain occurs after the pitch has been spread, work can proceed immediately.

The usual specification for blocks, grading, compacting the subgrade, etc., can be employed, but the writer would recommend that certain changes be made in other parts of the document. For instance, in describing the concrete the clause might be written as follows:

"On the subgrade prepared as above shall be laid the concrete base consisting of 1 part cement, 3 parts fine aggregate, and 5 parts coarse aggregate, mixed with sufficient water to produce a mass that can be readily floated. The surface shall be finished in one operation by means of a long-handled wooden float provided with up-turned ends to prevent ridging. The operation of finishing shall result in a surface which, when tested by a metal-shod straight-edge 5 ft. long laid upon it in a direction parallel to the curb, shall show no departure from this straight-edge greater than ¼ in. Projections greater than ¼ in. shall be trimmed down and all depressions shall be flushed even with a mortar consisting of 1 part of cement to 3 parts of sand."

When the foundation has hardened for the usual time and is thoroughly dry, it should be painted with a coat of pitch not more than ⅛ in. thick. This should be applied at a temperature of not less than 250 nor greater than 300 deg. F. and should be allowed to cool before laying the blocks. The writer wishes to call particular attention to the fact that pitch is specified both for the paint-coat and for the block-filler. Experience has shown that pitch adheres more firmly to both concrete and creosoted blocks, and is less affected by the action of the creosote oil than is asphalt. A specification which will insure proper material and which at the same time

CONCRETE MUST BE DRY BEFORE PITCH IS SPREAD, AND PITCH SHOULD BE HARD BEFORE BLOCKS ARE LAID

can be obtained from a number of different manufacturers could be written as follows:

"The pitch shall be the residue from the distillation of coal tar without admixture of any foreign substance and shall exhibit the following characteristics:

(a) Specific gravity at 77 deg. F., not less than 1.22 nor more than 1.34.

(b) Free carbon, not less than 18% nor more than 37%.

(c) Melting point determined by the "½-in. cube" method, not lower than 140 nor higher than 150 deg. Fahrenheit.

(d) When 100 g. are distilled at 670 deg. F. in an 8-oz. retort, the specific gravity of the distillate shall not be less than 1.07 at 100 deg. Fahrenheit.

When this pitch is used as a filler it is vitally necessary that it be used between the limits of temperatures specified above. It is not only not necessary to fill completely the joints between the blocks, but it is desirable that only enough filler should be used to fill about the bottom half of the joint. To secure this last result the heated pitch should be poured on the pavement and immediately and rapidly squeegeed in one direction. It has been found to be very poor practice to sweep sand into the joint before the filler is applied, as the sand fills the joints very unevenly and hinders the free flow of the pitch. The result is that when expansion occurs the pitch is squeezed to the surface of the pavement, failing to perform its function and, in addition, creating a decided nuisance. The practice of attempting to apply a second application by mopping a mass of pitch back and forth is to be condemned, as it often results in a residue of pitch being left on the surface.

A very good practice is to wet down the final sand covering and keep it wet for a short period after the pavement has been opened to traffic. This will keep the sand in place and allow the traffic to grind it into the joints and the wearing surface of the blocks. If a coarse sand is used this treatment will in a large measure prevent slipperiness.

Construction Details More Important than Specifications for Materials—Whenever the question of specifications for creosoted wood-block pavements comes before a technical gathering, the discussion is almost always limited to the character of preservative and to the method of treatment. There is no question that these elements are of much importance, but it is the writer's opinion that they are not of prime importance. No matter how carefully the blocks may be treated, nor how definitely the character of oil might meet the requirement best fitting it for service, nor how particular is the care taken to assure that the treatment has been properly carried out, the roadway will prove a failure if proper methods of construction are not followed. Experience has demonstrated the truth of this statement, and it seems strange, therefore, that there should be such a wide divergence of opinion as to what constitutes proper construction. As an example, note that the specifications recently adopted by the American Society of Municipal Improvements name three types of cushion and three materials satisfactory as fillers. This is purely a compromise, and as long as this attitude toward the question is held by engineers, no definite progress will be made. So much good paving-block is destroyed

A CONCRETE RICH IN MORTAR ALLOWS FINISHING WITH LONG-HANDLED WOOD FLOAT

on account of poor construction, and so much inferior block gives a partially satisfactory service because of proper methods of construction, that the three principal objections to a creosoted wood-block pavement are worthy of brief review.

It has been demonstrated absolutely that bleeding can be controlled by proper method of treatment, and that expansion, although sometimes resulting from the improper handling of seasoned timber, is generally due to faulty construction. It is common knowledge, also, that wood shrinks when it dries out and swells when it reabsorbs water. As long as the moisture content of a block remains slightly above the fiber saturation point of the timber from which the block is manufactured, it is at its maximum size and no shrinkage takes place until the moisture content falls. If the moisture content of a block is below the fiber saturation point, a very slight moisture addition greatly affects the size of the block. It is important, therefore, that blocks be so treated that the moisture content remains above the saturation point during the time precedent to laying, and that they be laid, if possible, in such a way that they will retain that degree of saturation. Unfortunately, too much dependence has been placed on the character and quantity of oil used in treating the block to obtain this result. No kind or quantity of oil will keep the water in or out of the block. It will greatly retard the absorption of water or drying out, and, therefore, the waterproofing quality of the oil must be taken into consideration.

But of equal, if not greater importance, is the detail of laying the blocks so as to prevent a change in their moisture content. The bituminous paint-coat will be found to effect an approach to this ideal more closely than any other detail.

It cannot be denied that sand-cushions or mortar-cushions with bituminous filler have resulted in many successful pavements, but a careful analysis of any construction job will reveal the fact that there have been a great many failures—many more, in fact, than would have resulted if the bituminous paint-coat method had been followed. Washington Ave., Olive St. and Pine St., downtown streets in St. Louis, Mo., which carry heavy

traffic, were paved about eight years ago with creosoted blocks on sand-cushions and with a sand-filler. In all cases the sand-cushion shifted badly, with the result that extensive repairs were necessary. But subsequent experience with a mortar cushion and bituminous-filler specifications has convinced the authorities that the paint-coat and pitch-filled specification is superior, and contracts have recently been let for this construction.

As far back as 1907 the city of St. Boniface, Manitoba, paved one mile of a country road outside of the city limits with a 16-lb. creosote block laid directly on a pitch-painted concrete base. The joints were filled with pitch and the surface was covered with a thin layer of sand. Although this road has been subjected to a range of temperature from 40 deg. below zero to 110 above zero, has no shade, receives no sprinkling, is neither swept nor cleaned, it is still, after ten years of use, in almost perfect condition. No shrinkage nor bulging has been noticed, and as far as can be learned, there have been no expenditures for repairs.

Many other instances of the failure of sand or mortar beds or cushions could be given, as well as many cases where the pitch paint-coat and bituminous-filler specifications have resulted in satisfactory service. But it seems sufficient to the writer to cite the above few instances to show the superiority of the method.

In conclusion, attention is directed to the possibility of using a shallower block on this type of construction than is considered possible with the sand-cushion or mortar-bed type of construction. Experiments made with blocks of 2¼ to 2½ in. depth indicate that satisfactory results can be obtained with this cheaper block. The lack of necessity for the lateral stability of the deeper block which was demanded by a non-rigid support, is in itself an adequate justification for the use of the shallower block.

Rapid Driving of a Short Tunnel in Black Hills Limestone

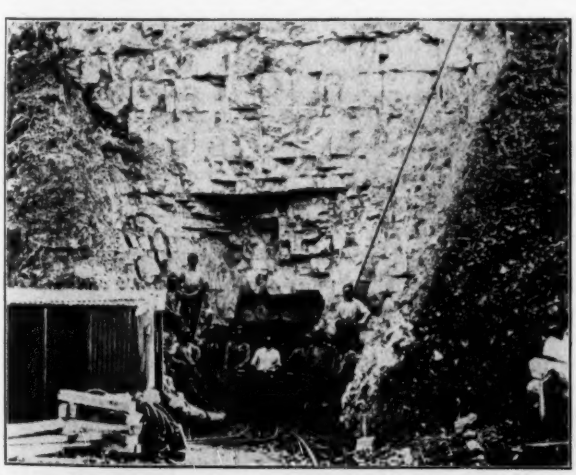
By H. L. Hicks
Ingersoll-Rand Co., New York

IN DRIVING the Homestake hydroelectric tunnel in the Black Hills of South Dakota, from Apr. 14 to Aug. 31 of this year, fast progress rates and low repair costs were realized.

The development consists of two tunnels, Iron Creek, 1096.7 ft. in length, and Long Tunnel, 3931.4 ft. With a 16.5-ft. adit these totaled 5044.6 ft. The work was contracted for by William B. Arndt.

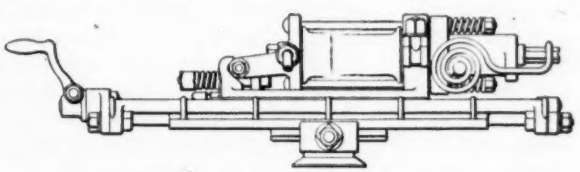
The ground was a medium hard limestone for almost the entire distance, the exception being 200 ft. of very hard flint. The tunnel measures 7 x 7½ ft., but overbreakage would make the average dimensions greater than 7 x 8 ft. Work was conducted from six headings, compressed air for all being supplied by a 537-cu.ft. steam-driven compressor. The air pressure at the compressor ranged from 115 to 120 lb. and the lowest pressure at any of the drills was 90 pounds.

All the drilling was done with "Jackhamers," four of the wet type and six of the dry type. Nine drills were operated and the tenth held as a spare. The four water-feed machines were clamped in feed shell mountings of a new type (see sketch) and used with 3-in. single-screw columns. The other drills were, by the operators' preference, hand-held to save time, as the drillers could get back to work as soon as the heading had been shot.



CHARACTER OF ROCK SHOWN BY FACE AT TUNNEL PORTAL

The drilling round consisted of 14 to 20 holes, the usual layout being four 7-ft. cuts and ten 6-ft. side holes. Cross bits on ⅞-in. hexagon steel and ⅞-in. 60% powder were used throughout. Machine-sharpened steels were supplied from a central blacksmith shop.



NEW MOUNTING USED ON COLUMN PROVED CONVENIENT FOR WATER DRILLS

The progress record is incomplete, due to periods when labor shortage made it necessary to halt work at one or another of the headings. The individual heading records are, however, rather remarkable. For instance, over a period of 41 days ending May 26, one heading was driven 8 ft. per shift or 24 ft. per day, the total being slightly over 1000 ft. Another heading, started May 2, was driven 350 ft. in 23 days of 3-shift work, running ten men per shift, using two drills. Still another case of consistent progress was that a third heading, where 1543 ft. were driven in 86 working days between May 3 and Aug. 10, with 14 men per shift handling two drills. During this run the round was shot seven times every two days while at the other headings they shot but three times each day.

As to the last-mentioned heading, the contractors comment that "the men never saw the inside of these machines and I never had one of them in the shop until the heading was in 1400 ft." indicates that little drilling time was lost and explains the excellent average of 17.9 ft. per day at this heading.

Summing it up, the Homestake tunnel was driven fast when a full crew made it possible. It is also to be noted that the drills set a good mark in low upkeep cost, the contractor recording a total repair expense of $289.85 or $0.057 per foot of tunnel.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

British Cast-Iron Pipe Specifications

Reviewed by JOHN H. GREGORY
Consulting Engineer and Sanitary Expert, New York City

BRITISH STANDARD SPECIFICATION FOR CAST-IRON PIPES AND SPECIAL CASTINGS FOR WATER, GAS AND SEWAGE: British Engineering Standards Committee—London: Published for the Committee by Crosby Lockwood & Son. Paper; 8 x 13 in.; pp. 35; illustrated. 1s. 4d. postpaid.

From the preface it would appear that these specifications for cast-iron pipe and special castings are the result of nearly fourteen years' consideration and deliberation, as the first committee appointed to consider the subject was named in October, 1903, and as it was not until July, 1917, that the final report was approved. As might be expected, the specifications will be found to be of greatest value to English water-works engineers, but some of their features are of especial interest to the American water-works engineer.

The text comprises 31 clauses covering the requirements for cast-iron pipe and special castings most frequently met with in practice. While space will not permit of reviewing these in detail, attention will be called to a few features not often seen in such specifications. Thus, in addition to those for straight spigot and socket pipes with plain sockets there are included also requirements for straight spigot-and-socket pipes with half turned and bored joints, as well as for straight flange pipes.

In the sections treating of the testing of the material by means of sample bars, it is provided that tensile tests shall be made as well as transverse tests. And for insuring the proper entry of the spigots into the sockets the specifications state that "the manufacturer shall provide and use iron templates of suitable dimensions which shall be passed to the bottom of every socket, and circular iron rings of suitable dimensions shall be passed over every spigot."

Further, in addition to the usual marking, each pipe is to have cast upon it the brand (a sketch of which is shown) indicating that the pipe purports to have been manufactured in conformity with the British standard specifications; in case of rejection of the pipe, the brand is to be immediately clipped off. And in addition to requiring a hydraulic test for each pipe, the engineer is given the power to have such a test applied to any special castings he may designate. The final clause provides for arbitration in case of dispute.

Following the text are 14 tables of weights and dimensions. Weights are given for four classes of spigot-and-socket pipe from 3 to 48 in. inclusive; but for flange pipe only up to and including 24 in. Weights for odd sizes, such as 5, 7, 9, 15, 21, 26 in., etc., are given.

No dimensions of flange special castings are included, and no weights whatsoever for any special castings are given. A note in the text, however, states that it is hoped to give such weights in a subsequent edition.

The specifications are well printed on good paper, on one side of the sheet only; but the size, 8 x 13 in., although bound on the long side, not only makes the pamphlet very inconvenient for a designing engineer or draftsman to handle but also to file. The arrangement of the dimensions in some of the tables could be very materially improved. For example, the inside diameter of the socket for any given size of pipe cannot be obtained directly, but must be obtained by addition. Again, the weights of the pipes are given in "cwts., qrs. and lbs." They could just as well have been given in pounds, as in all American specifications, and then it would be possible quickly to compare the two tables of weights.

Railway Engineers' Handbook in Spanish

Reviewed by DR. J. A. L. WADDELL
Consulting Engineer, New York City

INGENIERIA DE FERROCARRILES: La Teoria y Practica Fundemental De Ferrocarriles, Desde la Concepcion Del Idea Hasta la Terminacion Del Trazo—By Verne Leroy Havens, M. Am. Soc. C. E. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Leather; 4 x 7 in.; pp. 357; illustrated. $3.50.

In issuing a technical book in the Spanish language the publishers have inaugurated a movement which it is hoped will have a far-reaching effect; because anything that can be done to bring our great republic into closer touch with the Latin-American republics is a step in the right direction. It would certainly be greatly to the benefit of the United States if close business relations were established between it and all the Latin-American republics; and this desideratum must necessarily be accomplished primarily by the efforts of American engineers. In writing "Ingenieria de Ferrocarriles" Mr. Havens has certainly done his share of such good work; and it is to be hoped that other American engineers will soon follow his lead.

The text of the book appears to pursue the same sequence as does the work in the field. This is a logical arrangement and one which will appeal to most users of the treatise—which, by the way, is gotten out in pocket-book form—another very commendable feature.

The opening chapter, on "Commercial Considerations," contains much that may rightly be termed "horse sense." The second chapter is entitled "The Appreciation of Property by the Construction of Railways." Its opening paragraph reads: "We do not forget that engineering is more than a study of materials and a measuring of lands, that those studies are not the desired end, but only a fundamental aid which facilitates for us the solution of important problems. Treating only of professional works, it can be said that engineering is the science or art of investing money in such a manner that the interest rendered shall be the greatest possible, under given conditions; hence it is clear that the investing of funds in a project which produces nothing would be the acme of error." This is sound sense; and that commendable characteristic for engineering literature permeates the whole book.

The third chapter, "Reconnaissance for Route," contains a mass of sound, practical information of great value to those engineers upon whom falls the task of making reconnaissances. Succeeding chapters deal with "Organization and Equipment," the "Preliminary Survey or Study," "Topography and the Topographer," and a well-written description is headed "Work of the Office." The last-named is important enough to have been placed in a chapter by itself. Chapter VI, "Economic Problems," occupies 68 pages and contains a large inset diagram. The problems treated are practical and pertinent, including on p. 210 an interesting itemized distribution of cost percentages for certain South American railways. Chapter VII deals with "The Final Location," and is followed by a discussion of "The Adjustment and Care of Instruments." Various formula and tables complete the book.

The author's remarks in Chapter II concerning the increase in land values and tax returns due to the advent of a railway should be of great assistance to those who combine land development with railway building, and to those government officers who consider the advisability of subsidies or interest guarantees.

The inset diagram includes any combination of steam pressure, tractive power, cylinder dimension, driver diameter, piston speed, train speed, and coëfficients for speed factor and horsepower efficiency for simple locomotives. This does away with the usual cumbersome traction tables.

Curve resistance is considered analytically; and the resultant formulas indicate that the well-known classical experiments agree in virtually every instance with the analytical formulas, although they do not agree with many of the empirical formulas in common use. The author's method of dealing with vertical curves is new. Under the old methods of analysis it was apparent that vertical curves had to be of impossible lengths in order that their purpose might be fulfilled. Common practice has long since shown the fallacy of the old methods, and vertical curves are now introduced by empirical rules. The proper analysis, however, shows that the so-called empirical curves of standard practice are correct, and that the error lay in the old analysis. The metric curve system is used throughout the book, including complete tables for spirals or tapers for all ordinary curves.

This pocket manual should prove useful to any student of the Spanish language who desires to accumulate a vocabulary of technical terms employed in railroading; and for the engineer who contemplates working in Latin-American countries there is much of interest regarding the requirements of their various departments of public works.

Water Filtration and Chlorination

Pamphlets dealing with "Water Filtration" and "Water Chlorination" have been issued as Engineering Bulletins Nos. 9 and 10 of the Michigan State Board of Health. No. 9 is by Edward D. Rich, state sanitary engineer, and No. 10 by Mr. Rich and Earle L. Waterman. Each bulletin describes the process to which it is devoted. No. 10 also contains notes on 23 chlorinating plants in Michigan.

Elementary Textbook on Graphic Statics

Reviewed by J. P. J. WILLIAMS

First Assistant Engineer, Concrete-Steel Engineering Company, New York City

GRAPHICS—By H. W. Spangler. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6 x 9 in.; pp. 95; illustrated. $1.25.

One of the chief characteristics of this textbook, written for mechanical and electrical engineering students, is its clear descriptive explanations of the graphical constructions, aided by the use of bold-faced type in giving references to lines or points in the well-drawn diagrams.

The book is really a collection of notes of lectures as presented for many years by the late Dr. Spangler to his students at the University of Pennsylvania. There are no chapter headings, nor are the articles numbered. A logical order of presentation for the particular purpose is followed, the object being simply to cover the fundamental principles of graphics as applied to simple truss frames and to parts of machines. Both fixed and moving loads are considered, the familiar "free-body" method being adopted.

The descriptive explanations are sometimes too elementary, or confused by too great detail, while on the other hand in the later articles the tendency is to give graphic methods without sufficient emphasis upon the general principles upon which the construction is based; that is, the principles are buried under the verbal explanation of methods. Better paragraphing would have aided in preventing this tendency, and would have given the book better balance.

No table of contents is given by the publishers, but the subject matter includes the following—fundamental principles of equilibrium, force polygons and funicular polygons, simple truss frames with fixed and moving loads, deflections of trusses (Williot diagram), friction in machines, wedge and screw action, analysis of bell crank, horizontal engine, grasshopper engine, gears, chain and sprocket wheels, pulleys, belt friction, secondary beams, forces not in one plane, shafts, counterbalancing two cranks, three cranks and overhung cranks, crank arms perpendicular to shaft, etc., treated for combined bending, torsion and direct stresses.

The book is well presented by the publishers and should meet with approval in the limited field of its application to the needs of students.

The Control of Cast Iron

THE PRINCIPLES OF IRON FOUNDING—By Richard Moldenke, E. M., Ph. D. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 517. $4.

Dr. Moldenke probably aimed to produce a practical exposition of the science and art of iron founding that would benefit foundrymen principally. But he has done much more than that, for he has produced a one-volume library on cast iron. This text will be of immediate service to all engineers who are concerned in one way or another with the purchase of cast-iron products, or with the writing of specifications for cast iron, or with the foundry and shop inspection of these articles. From this volume the engineer can learn what foundry practices tend to prevent his getting what he desires in the way of physical qualities or chemical constitution, and it shows what practices should be employed to secure given ends. Cast-iron products have so broad a field of

service that it is difficult to find a class of engineers who may not profit sooner or later by turning to these pages.

The author first gives a brief, interesting commercial history of iron founding—here and abroad. Next he describes the effect of silicon, manganese, sulphur, oxygen, chromium, copper, nickel, vanadium, titanium, aluminum and magnesium. In connection with the notes on changes in physical properties induced by these reactions, Dr. Moldenke admits the possibility of curing some troubles by alloy additions to the ladles of hot iron, but he invariably recommends as better the blending in the cupola charge of high-grade pig and scrap, and maximum care in melting—his object being the prevention of trouble rather than the cure.

The next step is to outline iron and steel-making processes, giving briefly and simply the leading metallurgical reactions with comments on the similarity or divergence of foundry cupola practice, and the lessons the foundryman may learn from the experience of the steel makers. The author's thesis here is that simple melting is all that is desired, for the temperatures in the foundry are too low to attempt the chemical manipulations that are successful in steelmaking.

Engineers who desire to specify the kind of iron they are to obtain will appreciate the section in which castings are classified by their service—as acid-resisting, agricultural, engine-cylinder, car-wheel, chilled, electrical, flywheel, gun, stove, white, and more, in scores—with typical analyses, physical properties and a brief word on the foundry treatments earlier discussed at more length. There are large and important sections on raw materials, combustion processes and furnace construction, but these naturally will have less interest for most engineers.

In the appendices are a glossary of foundry terms and standard specifications for gray-iron castings, for sampling and analyzing iron, coke and refractories.

One of the most striking characteristics of the book is the prophetic nature of paragraph after paragraph; Dr. Moldenke continually points out new foundry practices that are, thanks to his skillful finger, so obviously improvements that they must earn extended acceptance. For many years to come the book will be in advance of the general state of the art and remain a guide to the developing industry.

Compensation Insurance

LIABILITY AND COMPENSATION INSURANCE: Industrial Accidents and Their Prevention, Employers' Liability, Workmen's Compensation, Insurance of Employers' Liability and Workmen's Compensation. By Ralph H. Blanchard, Instructor in Insurance. Wharton School of Finance and Commerce, University of Pennsylvania. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 394. $2.

The author goes into the history of industrial accident compensation, outlines the theory of insurance of this risk, and deals with the state compensation acts, and the stock company, mutual and state fund methods of insuring the payment of such compensation. He concludes that, because of insufficient data, a choice among these three methods cannot be made at present.

The author misses the determining factor in such a choice. This is, that the most desirable method of taking care of industrial accident losses is that which does most to prevent such losses. Of course, the private stock companies have done most in this direction, because accident prevention means more stability and larger profits to them. In spite of the fact that excellent work in this direction has also been done by state funds, these results are traceable to public-spirited and humanitarian motives on the part of individual office holders. In the present state of politics such motives cannot be relied on always to influence the conduct of every state fund so as to reduce accidents—at least in the same sense that their own financial advantage can be relied on to compel private companies to work for accident prevention.

To the book are appended the New York compensation act and an outline liability insurance contract.

Elementary Mechanical Drawing

Reviewed by ALTON L. SMITH

Professor of Machine Design, Worcester Polytechnic Institute, Worcester, Mass.

MECHANICAL DRAWING PROBLEMS—By Charles William Weick, B. Sc., Assistant Professor of Drawing and Design, Teachers College, Columbia University in the City of New York. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 153; illustrated; $1.25.

Of the three parts into which this book is divided, the first part (21 pages) describes drawing instruments and their uses, gives directions for lettering, outlines the general process of making a drawing, and explains useful geometric constructions for drawing tangencies and dividing angles.

Part 2 devotes 31 pages and 60 problems to elements of projection; 42 pages and 96 problems to the development and intersection of surfaces of simple geometric models; 22 pages and 44 problems to the methods of isometric and oblique drawings; and, finally, 24 pages and 70 problems introduce the young draftsman to the mysteries of machine details and the art of dimensioning.

The last ten pages contain tables of bolts, nuts, keys, pipe and other standardized material used in construction.

The book is well made and illustrated, but has no striking feature to distinguish it from other books of similar character. The exercises or problems are varied in nature and in degree of difficulty, so that the instructor can adjust a course selected from them to his particular needs. They are hardly up to the level of the work of the technical high schools, but should be useful for classes in the rural high schools and in evening schools, for which they are doubtless intended. The only portion which would interest the engineering student is the section on development of surfaces, and that because of its relation to sheet metal work.

Malingering by Workmen

MALINGERING AND FEIGNED SICKNESS: With Notes on the Workmen's Compensation Act, 1906, and Compensation for Injury, Including the Leading Cases Thereon—By Sir John Collie, M. D., J. P. New York: Longmans, Green & Co. London: Edward Arnold. Cloth; 6 x 9 in.; pp. 664; illustrated. $4.50.

For all employers subject to workmen's compensation acts this volume contains many useful suggestions while for the medical examiners for such employers and for state or company agencies which insure against accident or sickness it would seem to be of great value. It promises to be useful to employers who endeavor through a medical staff to keep their working force from being depleted through feigned sickness or injury—either of which is malingering. The volume also con-

tains valuable information for the medical branches of the army and navy. The larger part of the book is devoted to medical examinations and tests for the many kinds of ills to which mankind is subject and which may more or less successfully be feigned. The author states in his preface that the volume has been almost entirely rewritten. The first edition appeared in 1913.

Miami Flood Protection Studies

Five reports on important technical studies made in connection with the Miami Conservancy District flood-protection work are to be published shortly, according to an announcement just issued. Further reports in the same series will follow, so as to make available to all engineers the details of the many theoretical and experimental investigations required in connection with the work. The reports will be in 6x9-in. size, paper bound, and will be sold at 50 cents each.

The five reports about ready for publication are: Part I, The Miami Valley and the 1913 Flood; Part II, History of the Miami Flood Control Project; Part III, The Hydraulic Jump and Backwater Curves; Part IV, Calculation of Flow in Open Channels; Part V, Storm Rainfall of Eastern United States. They range from 120 to 320 pages in length. Part III contains the detailed results of very extensive experiments on the hydraulic jump and how the discharge channels must be shaped to take advantage of the jump, so as to produce harmless velocities at the point of final discharge of the water. Parts IV and V will include elaborate theoretical studies.

As the editions of the several volumes will be limited to the probable demand, engineers concerned with hydraulics, flood problems and hydrological questions are asked to subscribe or send notice of their desire to subscribe to the Miami Conservancy District, Dayton, Ohio.

Engineering Work of E. D. Leavitt

Those interested in the development of water-works pumping engines and other kinds of steam engines will welcome "An Account of the Engineering Work of E. D. Leavitt," by F. W. Dean, Boston, Mass., presented before the American Society of Mechanical Engineers at its annual meeting, Dec. 4 to 7, 1917. The paper has been printed by the Society (29 West 39th St., New York City) as a pamphlet of 47 pp. It contains a portrait of Leavitt and line drawings of his various engines.

More About "Phoenixiana"

Sir—The note concerning "Phoenixiana" on p. 936 of your issue of Nov. 15 recalls another incident, related in the report of that memorable survey, which the writer has frequently used as an illustration when remonstrating with some conscientious but misguided youth who has, for instance, computed the weight of a lattice bar to the thousandth of a pound. I refer to that occasion when the transit mentioned in your note was transported on the back of a mule, and when again it was desired to ascertain the exact time, the mule was "backed up into the plane of the meridian," the observation taken, and the time computed to the nearest second.

W. L. COWLES.

Oak Park, Ill.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

AMERICAN SOCIETY FOR TESTING MATERIALS: Affiliated with the International Association for Testing Materials. Proceedings of the Twentieth Annual Meeting held at Atlantic City, New Jersey, June 26-29, 1917. Part 1. Committee Reports, Tentative Standards; Part 2. Technical Papers. Edited by the Secretary-Treasurer, under the regulations governing publications. Philadelphia, Penn.: The Secretary, University of Pennsylvania. Cloth; 6 x 9 in.; pp. Part 1—875; Part 2—675; illustrated.

APPLIED MOTION STUDY: A Collection of Papers on the Efficient Method to Industrial Preparedness—By Frank B. Gilbreth, Consulting Management Engineer, Member Franklin Institute; M. Am. Soc. M.E.; Society for the Promotion of Engineering Education, and L. M. Gilbreth, Ph.D., New York: Sturgis & Walton Co. Cloth; 5 x 8 in.; pp. 220; illustrated. $1.50.

ASPHALT, RELATED BITUMENS, AND BITUMINOUS ROCK IN 1916: By John D. Northrop. Mineral Resources of the United States, 1916—Part II. (Pages 263-281.) Washington, D. C.: United States Geological Survey, Department of the Interior. Paper; 6 x 9 in.; pp. 18.

CITY AND COUNTY ADMINISTRATION IN SPRINGFIELD, ILLINOIS: A Survey by the Department of Surveys and Exhibits, Russell Sage Foundation. D. O. Decker, Shelby M. Harrison. The Springfield Survey, Government Efficiency Section. New York City: Department of Surveys and Exhibits, Russell Sage Foundation. Paper; 6 x 9 in.; pp. 152; illustrated. 25c.

THE EFFECTS OF EXPOSURE ON SOME FLUID BITUMENS: By Charles S. Reeve and Richard H. Lewis. Reprinted from the Journal of Industrial and Engineering Chemistry. Vol. 9, No. 8, page 743. August, 1917. Paper; 6 x 9 in.; pp. 11.

BENGAL SMOKE-NUISANCES COMMISSION: Report for 1916-1917. Calcutta, India: The Bengal Secretariat Book Depot. Paper; 8 x 13 in.; pp. 4. 3d.

EVAPORATION FROM THE SURFACES OF WATER AND RIVER-BED MATERIALS: By R. B. Sleight. Reprinted from Journal of Agricultural Research. Vol. X, No. 5. Washington, D. C., July 30, 1917. Published by authority of the Secretary of Agriculture, with the coöperation of the Association of American Agricultural Colleges and Experiment Stations. Washington, D. C.: The Author, United States Department of Agriculture. Paper; 7 x 10 in.; pp. 52; illustrated.

INFLUENCE OF GRADING ON THE VALUE OF FINE AGGREGATE USED IN PORTLAND CEMENT CONCRETE ROAD CONSTRUCTION: By F. H. Jackson, Jr. Reprinted from Journal of Agricultural Research. Vol. X, No. 5. Washington, D. C., July 30, 1917. Published by authority of the Secretary of Agriculture, with the coöperation of the Association of American Agricultural Colleges and Experiment Stations. Washington, D. C.: The Author, United States Department of Agriculture. Paper; 7 x 10 in.; pp. 12; illustrated.

IOWA ENGINEERING SOCIETY: Proceedings of the Twenty-Ninth Annual Meeting, held at Ames, Iowa, February 21-23, 1917. Iowa City, Iowa: The Society. Paper; 6 x 9 in.; pp. 183; illustrated.

KING'S SEGMENTAL CONSTANTS FOR CIRCLES AND SPHERES: Copyrighted 1917, by Leon T. King, C. E. Ilion, N. Y.: The Author. Paper; 4 x 7 in.; pp. 11. 35c. each; 3 for $1.

STATE HOUSING MANUAL: Containing the State Tenement House Act, State Hotel and Lodging House Act, State Dwelling House Act—Annotated—San Francisco, California: Commission of Immigration and Housing of California. Paper; 6 x 9 in.; pp. 118; illustrated.

GEOLOGY OF MASSACHUSETTS AND RHODE ISLAND: By B. K. Emerson. Washington, D. C.: United States Geological Survey, Department of the Interior. Paper; 6 x 9 in.; pp. 289; illustrated; folding map.

TECHNIC OF SURVEYING INSTRUMENTS AND METHODS: Including General and Detailed Instructions for Field and Office Work of Extended Students' Surveys—By Walter Loring Webb, C. E., M. Am. Soc. C. E., and John Charles Lounsbury Fish, C. E., M. Am. Soc. C. E. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Leather; 4 x 7 in.; pp. 319; illustrated. $2.

TOUGHNESS OF BITUMINOUS AGGREGATES: By Charles S. Reeve and Richard H. Lewis. Reprinted from Journal of Agricultural Research. Vol. X, No. 7. Washington, D. C. August 13, 1917. Published by authority of the Secretary of Agriculture, with the Coöperation of the Association of American Agricultural and Experiment Stations. Paper; 7 x 10 in.; pp. 14; illustrated.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

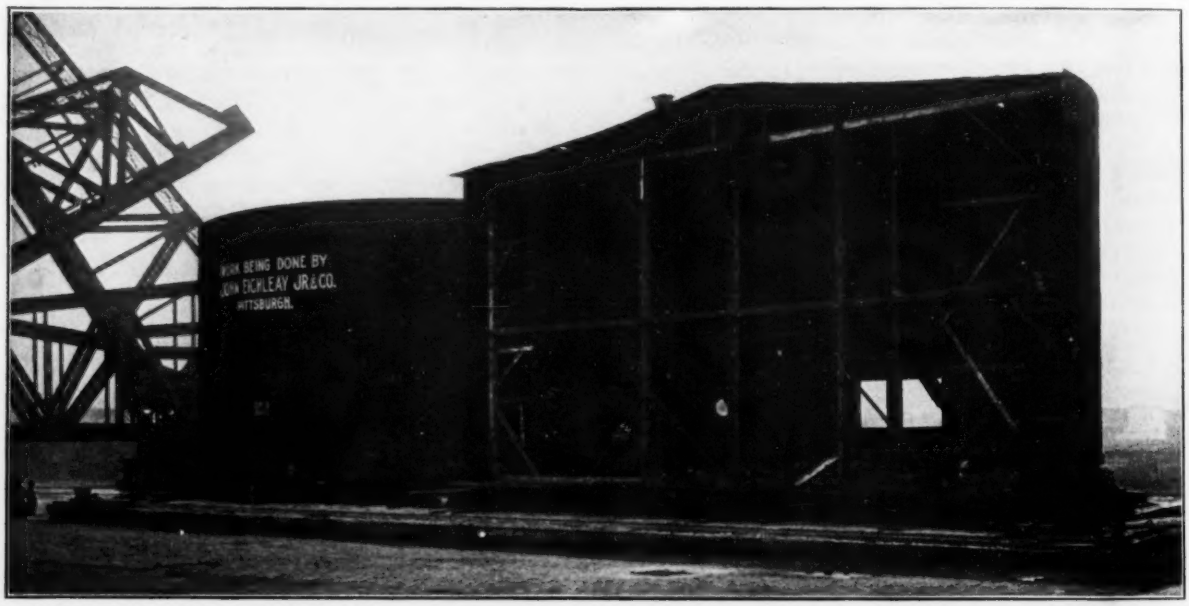
Cut Tanks in Two To Get Them by Drawbridge on Scow

By E. Dauenhauer
John H. Eichleay, Jr., Co., Pittsburgh

IN MOVING two dozen tanks a distance of 15 miles from South Chicago across the lakes and up the Chicago River to West 36th St., the John H. Eichleay, Jr., Co., in charge of the work, discovered that several of them were too large to pass through the channel. The tanks whose diameter exceeded the clearance between piers of the drawbridges were cut in halves, and the open side of each half was braced with timber falsework.

Each half was braced with a top and bottom chord and five posts, all made of 6 x 8-in. timbers. The knee-braces shown in the photographs were of 3 x 8's, well spiked to the horizontal timbers and posts. To make the bracing effective the tank was drawn against it by stretching horizontally across the open end of each half four ¾-in. wire ropes spaced equally from top to bottom. These cables were clipped to eye-bolts through rivet holes and drawn taut with turnbuckles.

The tanks which had been cut in two were successfully reassembled by moving the halves together and adjusting them with jacks until the rivet holes matched.



TANKS WERE BRACED WHERE CUT WITH SIX- BY EIGHT-INCH TIMBERS

Fuel Committee's Coal-Saving Pointers Apply to Contractors' Firemen

THE coöperation of firemen is the most important part of the plan to save 50,000,000 tons or more of coal this winter, according to the Committee on Coal Conservation of the Chamber of Commerce of the United States. This amount of coal, it is said, represents but one-third of the quantity that is usually wasted each year. Contractors are large users of coal fired by hand in locomotive boilers, and even in normal times a little coal conservation brought about by some intensive work directed at the firemen by the master mechanic would be very much worth while.

The committee mentioned calls attention to the well-known fact that fires kept up by putting in small quantities of coal frequently and covering only the thin spots are the most economical. It recommends that with a 6 x 9-ft. grate (which is rather big for a portable boiler) 100 lb. every 10 min. or less is sufficient. The thickness of fire recommended is from 4 to 8 in., according to the size of coal and the force of draft.

The fireman can be much more efficient, says the committee, if he will take small shovelfuls, stand directly in front of the door where he can see where to throw the coal, and fire quickly and rapidly. Of course, the ashpit should be kept clear and the flues should be cleaned regularly if anything is to be accomplished in the way of saving coal.

The committee cites an instance of one boiler installation where a bonus was offered to firemen using less than a certain amount of coal to keep up the required head of steam. In the first month of operation the bonuses amounted to a raise of 10% in the firemen's wages. Even if the bonus offered should be equal to the value of the coal saved, the employer is not a loser; and if contractors generally would try some such system, the total saving of coal would be considerable.

Inexpensive Iron Roller Guides Cables

AN ELABORATE system of cableways is in use in the work of raising three dams, which the Southern California Edison Co. is carrying out at Huntington Lake, Calif. Where these cables pass around bends, an inexpensive type of idler is used which has been found so satisfactory that it has been made standard for this service. These idlers are made up of short lengths of 4-in. pipe, to the ends of which are threaded 4-in. to 1-in. reducers. In the small ends of these reducers 1-in. steel bolts run free as axle in bearing. These steel bolts, projecting 2 or 3 in. from the bushing, constitute inexpensive bearings which are easily mounted on post or tie. Thus the advantage of a large diameter idler is obtained with slight expense and inconvenience in the matter of bearings.

The work of raising the dams was described in *Engineering News-Record* of Dec. 6, p. 1044.

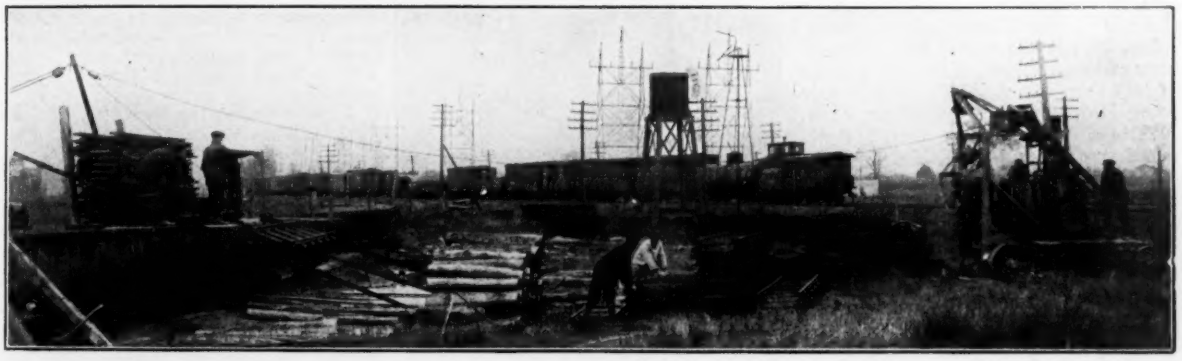
Make Use of Mixer Engine to "Load Up"

BY H. F. VAN SCOYOC
Chief Engineer, Toronto & Hamilton Highway Commission

THE drum of a concrete paving mixer, a gin pole, some blocks, a piece of cable and a skidway doubled the output of a gang of six men engaged in laying sections of industrial railway track of the Toronto and Hamilton Highway Commission at its yard at Oakville, Ontario.

A similar rigging with the addition of a suitable runway and two 1½-yd. dump cars enabled the same crew to reload from a stock pile a 50-ton sand car in the short time of 2 hours and 20 minutes.

BUILDING-WORK METHOD SAVES ON ROAD CONSTRUCTION



PAVING MACHINE WITH SIMPLE RIGGING ENABLES GANG TO LOAD INDUSTRIAL TRACK ON RAILWAY CARS TWICE AS FAST AS BEFORE

Track-Pit and Bucket Elevator for Handling Stone on Road Job

BY WILLIAM HALVEMBERGH
New York City

CONFRONTED with the problem of unloading cheaply 5000 tons of broken stone for a concrete road, Mascetti & Holley, contractors of Torrington, Conn., assembled some second-hand machinery and set up a track-pit and elevator installation similar to those becoming popular with reinforced-concrete building contractors. A bucket elevator was taken from an old stone-crushing plant owned by the firm and mounted so as to dig stone from the pit into which it was dumped from the railroad cars. The elevator raised the stone about 10 ft. and dumped it into bins from which it could be drawn through gates into industrial cars.

A small gasoline engine was first used to run the bucket elevator, but did not develop sufficient horsepower. In consequence a 12-hp. electric motor was substituted. This plant cost little besides the labor required to put it up, but several cents per ton on the cost of handling the stone were saved by it.

Speaking Campaign To Increase Lumber Output

A corps of speakers has been organized and sent out among the Southern lumber towns by the Southern Pine Association, to address men employed in lumber mills at logging camps, in order to bring the war home to them and arouse them to greater efforts in the production of timbers for wooden ships.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Harris Resigns as Manager of Fleet Corporation

Admiral Asks To Be Relieved and Piez Becomes Head of Merchant Shipbuilding Work

Rear Admiral Frederick R. Harris, U. S. N., who on Dec. 1 assumed the position of general manager of the Emergency Fleet Corporation, on his own request was relieved of that position on Dec. 17. No official reasons are given for this unexpected move and his future assignment has not been made public.

Charles A. Piez, who was made vice president of the Emergency Fleet Corporation about a month ago, has been named as general manager of the corporation to succeed Admiral Harris. Mr. Piez is a mechanical engineer, whose whole professional experience since his graduation from the Colorado School of Mines in 1889 has been with the Link-Belt Engineering Co. and the affiliated Link-Belt Co. For many years he was chief engineer of the former concern, and at the time of his appointment to the Fleet Corporation he was president of the Link-Belt Co. in Chicago. He is 57 years of age.

Mr. Piez is the fourth general manager of the corporation in its short life of less than one year, his predecessors being Maj. Gen. G. W. Goethals, U. S. A., Rear Admiral W. L. Capps, U. S. N., and Rear Admiral F. R. Harris, U. S. N. All of the major officers of the corporation and the present Shipping Board are now civilians.

Civil Engineer Parks Named Head of Yards and Docks

On Dec. 18 the President sent to the Senate for confirmation as chief of the Bureau of Yards and Docks of the Navy, the name of Charles Wellman Parks, civil engineer, U. S. N. Mr. Parks stands No. 5 on the list of civil engineers in the corps and has for a year or two past been in charge of the Pearl Harbor drydock in Hawaii.

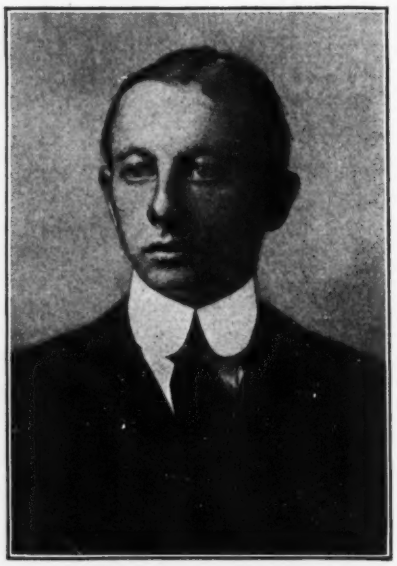
Boulder Wants a City Manager

Applications for the position of city manager are wanted by Boulder, Colo., a city of 12,000, in which a new charter will take effect on Jan. 1. To attract good men it is announced that there are "big problems in water-supply, paving, parks and drainage" for the city manager to tackle, and that the salary to be paid will depend upon the man. Applications should be made to O. P. Clark, city clerk.

News-Record Sends R. K. Tomlin, Jr., to Front as Correspondent

Robert K. Tomlin, Jr., managing editor of *Engineering News-Record*, sailed recently for France to serve *Engineering News-Record* and the other papers of the McGraw-Hill Publishing Co., Inc., as special war correspondent.

Mr. Tomlin was graduated from Harvard University in 1907. During his college course he served for two summers as assistant in the surveying and railroad field engineering of the Harvard Engineering Camp at Squam Lake, New Hampshire.



ROBERT K. TOMLIN, JR.

Shortly after graduation he entered the employ of the Pennsylvania R.R. on the tunnel work in connection with the Pennsylvania Station in New York City. He left this work to go to the New York Board of Water-Supply, and was stationed with the Northern Aqueduct Department at Poughkeepsie, New York.

His journalistic experience dates from March, 1909, when he became assistant to the editor of the *Engineering Record*. He was subsequently made associate editor, in charge of the municipal and sanitary field, and in 1913 was promoted to the position of managing editor.

When *Engineering News-Record* was formed last April by the consolidation of *Engineering News* and the *Engineering Record*, Mr. Tomlin was made managing editor.

Engineers' Conduct in Battle Wins Tribute from Haig

Letter of Thanks to Pershing Speaks Warmly of Their Gallant Action in Fight at Gouzeaucourt

In Field Marshal Haig's letter of thanks to General Pershing for the assistance given by American Army engineers in the fight at Gouzeaucourt, when the Americans dropped their other work, seized rifles and helped to repel a German attack, the British commander paid a high tribute to the engineers. His letter reads:

General Headquarters,
British Armies in France,
Dec. 6, 1917.

My Dear General Pershing:

I have much pleasure in forwarding herewith for your information a copy of a report submitted to me by General Byng, commanding the Third British Army, on the gallant conduct of companies of railway engineers of the United States Army in and near Gouzeaucourt on the 30th of November.

I desire to express to you my thanks and those of the British forces engaged for the prompt and valuable assistance rendered, and I trust that you will be good enough to convey to these gallant men how much we all appreciate their prompt and soldierly readiness to assist in what was for a time a difficult situation.

I much regret the losses suffered by these companies.

Yours very truly,
D. HAIG.

Atlanta Incinerator Steam May Be Used

A written proposition to buy all electric current that could be generated by utilizing steam produced at the city refuse incinerator, Atlanta, Ga., has been made by the Georgia Railway and Power Co. The company would transmit to the city water-works pumping station all current generated by the city at the incinerator and pay the city the same rate (0.6c. per kw.) as the city is now paying the company for the pumping-station service. The incinerator steam has been wasted since the incinerator was put into use some four years ago. The incinerator was built to burn 250 tons of refuse a day, which it was estamited would produce 1500 kw. of current. Owing to war-time economy the refuse going to the incinerator has fallen to 150 tons a day. It is expected that the 1918 city budget will contain an item of $40,000 to $60,000 for an electric generating plant at the incinerator, in accordance with a recommendation adopted Dec. 17 by the outgoing City Council.

American and Canadian Societies To Coöperate

In answer to a letter apprising it of the resolutions passed by the American Society of Civil Engineers, the Council of the Canadian Society of Civil Engineers passed and forwarded the following resolutions:

"Whereas, the Council of the Canadian Society of Civil Engineers has received a copy of the resolutions adopted by the Board of Direction of the American Society of Civil Engineers at a meeting held on Oct. 9, 1917, expressing the desirability of the closest coöperation and cordial relationship between the American Society of Civil Engineers and the Canadian Society of Civil Engineers, and

"Whereas, the Council of the Canadian Society of Civil Engineers is in full accord with the sentiments and principles so clearly enunciated in the said resolutions, therefore be it

"Resolved, that the Council of the Canadian Society of Civil Engineers cooperate with the Board of Direction of the American Society of Civil Engineers to the end that the terms of the said resolutions may be carried into effect, and that the Council reciprocate the action of the Board by inviting the members of the American Society of Civil Engineers to take advantage of the facilities offered by the Canadian Society of Civil Engineers and make themselves at home in its rooms and attend its meetings whenever they may visit Montreal.

"Be it further resolved, that a committee of the Canadian Society of Civil Engineers consisting of the president, a past president and two members of Council be requested to communicate with the Board of Direction of the American Society of Civil Engineers with a view to making arrangements for giving effect to the terms of the said resolutions."

Erie Flood Prevention Work To Be Relet

Gannett, Seelye & Fleming, engineers, of Harrisburg, Penn., took over the Mill Creek improvement at Erie, Penn., from the contractors, the Metz & Roth Construction Co., and expect to let it, under the Metz & Roth contract, on a cost plus percentage basis.

This action was taken after the Metz & Roth Construction Co. had served notice on the Erie City Council that it would not complete the work, asserting that the contract had not been certified and therefore was not binding upon the company.

Gen. Goethals To Have Charge of Army Supplies

In the organization of the new War Council, announced Dec. 17, Maj. Gen. George W. Goethals was recalled to active duty and was appointed acting quartermaster general in place of Major General Sharpe.

Storage at Seaboard and Interior Necessary To Prevent Freight Congestion

F. L. Stuart of War Industries Board Storage Committee Outlines Method of Getting Supplies to War

Sufficient and properly distributed storage areas for the rapidly increasing mass of freight rushing toward France is the solution of the Atlantic seaboard freight congestion problem, according to Francis Lee Stuart, consulting engineer, New York. Mr. Stuart, as is well known to engineers, has been chief engineer of both the Erie and the Baltimore & Ohio R.R., and is chairman of the Terminal Ports Facilities Committee, which is part of the Storage Committee of the War Industries Board. Since early summer this subcommittee has been engaged in the terminal problem as it relates to the transport of military supplies in France, and a number of its recommendations to the War Department are now in process of execution. Mr. Stuart outlined some of these recommendations in an address on Dec. 14, before the annual meeting, in New York, of the Acadamy of Political Science. In part, he said:

Military Control of Resources

"The resources of the country will produce the needed military supplies, and it therefore is absolutely essential that such supplies should be so distributed that they will finally be in actual military control, so that there is a dependable quantity for use when and as needed. The Terminal Ports Facilities Committee and the Storage Committee of the War Industries Board have recommended to the Depot Board of the War Department that (a) storage areas and port facilities be created abroad for holding ——— months' supplies; (b) that storage areas under military control be created at Atlantic ports to hold in storage several months' supplies, and that a number of ports be used instead of two or three; (c) that interior storage areas be provided near the source of production for the collection of carload or trainload shipments to the terminal ports.

To Keep Supplies Moving

"In operation, as the storage reserve abroad is drawn on for use at the front it is replenished by requisition from Atlantic terminal ports, which in turn are kept up to a fixed reserve by moving up supplies in an orderly manner from the source of production.

"Speaking as an individual, as an engineer, and not as a member of any committee, I want to explain some of the logic involved in such an obviously simple recommendation and its bearings on the present transportation congestion.

"The ports selected were selected because the export and import shipment business of the United States for the past 20 years has built up interior transportation facilities in proportion to the business of the various ports, and in this emergency there is no time or man power to create greater railroad facilities than now exist, and the entire country's rails, north, east, south and west, should be used to an economical advantage.

"Engineering students of transportation know that the present methods of export transportation in trying to have cars meet ships or cars held to load direct to ships should be abandoned as inefficient and uncertain; that the priority orders cannot be depended upon for any continuous effort, as they will disrupt and break down any organization, be it for transportation or for commercial purposes, so that storage areas at the ports to unload cars into immediately upon their arrival, and capable of holding several months' supplies available by lighters, truck or car for loading quickly any ship offered without delay, are essential.

Must Provide for Expansion

"The storage areas require size for expansion, as the uncertainties of the war are such that no man can foresee whether we will have to furnish military material for 2,000,000 or 4,000,000 men, or even a greater number. It is wise in planning for such a movement that the areas selected should be large enough easily to take care of a storage which can be expanded as required to meet the varying emergencies which may arise, without having to create new organizations or educate large forces in new methods.

"It is necessary to build storage areas, for there are no suitable storage areas available which are unoccupied by industries. The necessities of war will have a disastrous enough effect on the economic wealth of the country, even with well-thought-out endeavors to conserve the earning power of the community without tearing down or disrupting going concerns, which in their indirect way, if not in a direct way, are necessary for the sake of our continuing strength.

Safety from Fire

"Warehouses and layouts of the storage areas are designed for the purpose of safety from fire or other risks, quickness of dispatch to ships, efficiency and simplicity of operation, and while they are close enough to rail facilities which serve the ports, they are segregated and their operation should not greatly interfere with the other efforts of the country.

"Piers and berthing spaces for ships are available at every port, and it is recommended that we conserve man power and materials by using such facilities as loading places for ships with materials from the nearby storage areas.

"In 1913, had the business of the country been normally progressive, the railroads would have been unable to avoid congestion, as their improvements were not abreast with their needs Without new facilities being added the congestion of today was a certainty from every angle. Such congestion has been added to by the abuses which have been permitted by the Government, such as priority orders and unrelated efforts which result in use of cars for storage.

MUST RELEASE FREIGHT CARS

"What can we do to avoid such congestion? In my opinion, the greatest useful relief that can come in this crisis is the physical coördination of the railroads, and from a public opinion which demands a change in our business methods and which will coerce an immediate unloading and release of a car. This will require readjustment of business sites in the end, but the methods which will be most intensively used to accomplish such a result are the establishment of a storage place as a part of a business policy in every plant, and a greater use of the already prepared roads, such as a city street, for distribution by trucks and other means which do not require special tracks.

"The war is an epoch in our history, not an emergency. Such an inefficient and disorganizing tool as priority orders should not be used except in a national emergency. Restraining or non-essential orders could be tried with less risk."

To Connect Imperial Valley Canal System with Laguna Dam

Press reports from Washington announce that the delegation from Imperial Valley appearing before Franklin K. Lane, Secretary of the Interior, has received permission to connect the canal system with the Laguna dam, provided the Imperial District bears the expense. Great difficulty is experienced, the delegation explained, in obtaining sufficient water to irrigate the valley, and connection with the Laguna dam would solve this problem and make possible the future construction of a canal that shall be entirely within the United States.

In granting permission for the connection, Secretary Lane suggested that before the construction was undertaken the people of the district should be allowed to vote on the plan of building a series of storage dams in the Colorado River and its tributaries, which would increase the water-supply during low water. These dams would require Congressional action in granting permits and appropriating funds for construction, the funds to be repaid after a period of years by the water users.

The delegation, consisting of C. E. Grunsky, consulting engineer for the district, and several prominent irrigationists of Imperial Valley, agreed to submit both matters to the people of the valley and report results.

Chicago Paving Report Once More in the Limelight

Officially, the controversy in Chicago over a report made in 1916 by Prof. Ira O. Baker, consulting engineer, on pavements laid by the Board of Local Improvements, has probably been given final attention. On Dec. 10, the finance committee presented to the City Council a report by the committee's engineering staff covering four of the most serious conclusions drawn by the consulting engineer, in which the latter alleged, by inference at least, extensive losses to the city on account of deficiencies in the thickness of concrete foundations, asphalt binder course and asphalt wearing surface, and in the percentage of bitumen in asphalt mixtures.

The staff report concludes that the consulting engineer was in error in assuming that deficiencies existed in the thickness of pavements all over Chicago, when data furnished to him by the staff reported a deficiency in only five foundation jobs out of 63 inspected, five binder jobs out of 10 inspected and six wearing surfaces out of 20 inspected.

CONSULTING ENGINEER CRITICIZED

As to the question of the low percentage of bitumen, the staff report holds that it was supplied with erroneous information, which in turn was supplied to the consulting engineer. Further, it questions the propriety of his assuming a deficiency in the percentage of bitumen in any large quantity of paving based on one inspection and no analysis.

Much acrimonious discussion of the report has taken place. Eight inspectors of the Board of Local Improvements had charges preferred against them, alleging dereliction of duty in permitting the alleged skimping, their cases being tried by the Civil Service Board. They were exonerated (see *Engineering News-Record* of Apr. 19, p. 173). Last summer the president of the Board of Local Improvements preferred charges against the finance sub-committee's staff, which is virtually the former efficiency division of the Civil Service Commission. These alleged that erroneous information had been furnished to the consulting engineer. The present report by the staff to the sub-committee grew out of these charges, which have recently been dismissed.

Comments upon the original report, submitted by C. D. Hill, engineer of the Board of Local Improvements, Prof. F. H. Newell and Prof. Baker, will be found in *Engineering Record* of Jan. 20, p. 115, and March 3, p. 357; and in *Engineering News* of Jan. 4, p. 39, and Feb. 15, p. 288.

None of the committees of engineering societies which took up the matter has yet reported back to its respective society. The original report was abstracted in *Engineering Record*, Dec. 9, 1916, p. 702.

A Most Appropriate Holiday Gift

You can hit upon no finer expression of your good will to your responsible men than to make them a gift of a year's subscription to the paper that is published to help them to improved and economical results in their work.

Most holiday gifts are outworn and forgotten in a few months; but here is one that lives and grows with each week—one that will be a constant reminder to your men of your interest in them.

We have prepared an appropriate card announcing your gift. This will be mailed to each recipient, together with the Christmas number of *Engineering News-Record*, which will be complimentary, his subscription being entered as paid up to Jan. 1, 1919.

The time is growing short—so let us have your list without delay.

Locher Engaged as Contractor for Miami Conservancy District

The Miami Conservancy District has entered into an agreement with Charles H. Locher, an experienced contractor, and will coöperate with him in constructing the flood-prevention works of the district. Mr. Locher was formerly engaged as contractor on the construction of the Shoshone dam, in underwater rock excavation at the Soo, on the Wachusett dam, the New York barge canal and the Catskill aqueduct.

The district and Mr. Locher are now working together to build up an effective construction organization. It is expected to have the construction in full progress by late spring. The first issue of the bonds of the district, amounting to $10,000,000, was placed on the market last week, and it was reported that they were about two-thirds sold. The work consists of the construction of five earth dams, from 70 ft. to 130 ft. high, and the improvement of the Miami River channel through the various cities of the valley. The work will include the moving of about 20,000,000 yd. of earth, the placing of about 300,000 yd. of concrete, and a large amount of miscellaneous construction.

Will Clear Up Halifax Wreckage

Col. Robert Smith Low, of Ottawa, Ont., has been placed in charge of the work of clearing up the wreckage caused by the Halifax explosion, preparatory to rebuilding. He was born at East Saginaw, Mich., in 1874, and after some years' experience in connection with his father's contracting business became a partner in the firm of McManus, Low & McManus, general contractors, of Sydney, N. S., in 1900, and shortly afterward head of the R. S. Low Contracting Company.

In 1912 he became associated with Bate, McMahon & Co., of Ottawa. Colonel Low has supervised a number of important contracts, including that for the plant of the Dominion Iron and Steel Co.

Army Engineers Praised by the Secretary of War

In Annual Report He Tells of Their Work and Recommends Enlarged Engineer School

In the annual report for the fiscal year 1916-17, Newton D. Baker, Secretary of War, gives a slight idea of what the engineer troops have so far done and what lies before them. The paragraphs are as follows:

THE ENGINEER DEPARTMENT IN WAR

This great division of the War Department in times of peace devotes the major part of its energy to works of internal improvements and to the supervision of, improvement, and maintenance of navigable waters; but in time of war it immediately becomes a fundamental part of the Military Establishment. It was, therefore, called upon not only to render assistance of an engineering kind in the establishment of training camps, but had to establish camps for the rapid training in military engineering of large additions to its own personnel, and to undertake the rapid mobilization and training of additional engineer troops, of which at the beginning of the war there were but two regiments.

One of the earliest opportunities for actual assistance to the countries associated with us in this war was presented to this department. In the war against Germany transportation, and particularly railroad transportation, is of the utmost importance. It was easily foreseen that our own army in France would require large railroad facilities both in the operation of permanent railroads for the handling of our equipment and supplies and in the construction and operation of temporary roads behind our army. In the meantime regiments of engineer troops, if speedily organized and dispatched to Europe, could both render valuable assistance to the British and French armies and acquire the training and experience which would make them valuable at a later stage to us. Accordingly nine such regiments were organized and have for some months been rendering active and important service along the actual battle front. In addition to these, a tenth regiment, composed of men skilled in forestry and lumbering, was organized and sent abroad, and is now operating in a foreign forest cutting out lumber supplies for the use of our associates and ourselves.

Concurrently with the formation of these special engineer troops the department undertook the collection of material for the establishment and operation of our own lines of supply abroad. The railways of France have been maintained in a state of high efficiency by the French people, and they are performing the tremendous transportation task imposed upon them by the French and English military operations with complete success; but in order not to impose a burden which they were not designed to meet, by asking them to expand to the accommodation of our services, it has been found necessary for us ourselves to undertake the accumulation of railroad material for our own use in the theater of war. This work is on a large and comprehensive scale. Any detailed description of it would be inappropriate at this time, but it involves the creation of entire transportation systems and the actual construction and operation of railroads with the elaborate terminal facilities needed for the rapid unloading and dispatch of supplies, equipment and troops.

In my annual report of last year I pointed out the inadequacy of the engineer school maintained at the Washington Barracks and expressed the hope that the intention of Congress could at some suitable time be called to the wisdom of providing facilities for original research and continuous and fundamental training for our body of engineers. The experience of this war emphasizes the suggestion then made. The engineer is the bridge over which discoveries of science pass into the practical uses of everyday life. There should, therefore, be a school for army engineers which would keep constantly engaged upon research and as constantly engaged in devising modes and appliances for the application of scientific discoveries in military matters. In the present war, as doubtless in all wars, the inventive faculty is aroused to unwonted activity; not only do our own scientists and inventors produce discoveries and inventions which can be adapted to immediate military use, but our adversaries are likewise fertile and appear on the battlefield with new agencies and appliances which must be met defensively and surpassed offensively. These observations, of course, are equally applicable to the work of the Ordnance Department, and beginnings have been made in that department at the proving ground which will doubtless some day result in ordnance schools of a higher kind which will continue the practical education received by the young ordnance officer in his tour through the arsenals and proving grounds, and will select out for special duty men endowed with research ability and special inventive skill.

RECOMMENDS BIGGER ENGINEER SCHOOL

The Engineer School has, however, already a fair start and by relatively small appropriations it could be expanded into a great scientific agency, valuable to the country in times of peace and of the highest value under the stress of war. I beg leave, however, to urge that when Congress does address itself to this problem its plans be conceived in a broad and generous spirit. The education system of the Army, beginning with the Military Academy at West Point and following through the service school and the War College, should be rounded up by the construction of a scientific institution with laboratory facilities and experimental resources, to which the Regular Army officers could have recourse for the final training of their special talents. It should be an institution working in the closest coöperation with the great educational institutions of the country and so officered that the military value of the great research output of civilian educational and scientific laboratories would be constantly discovered and made available. In the present war the laboratories and facilities of the colleges and universities of the country have been placed at the disposal of the Government. The Bureau of Standards, under the generous direction of the Secretary of Commerce, has placed its services unreservedly at the disposal of the technical branches of the Army, and by this coöperation the department has been able to effect many standardizations and the simplification of many processes of great value both in production and speed.

ENGINEERING DEVELOPMENT NECESSARY

This sort of coöperation, of course, can always be relied upon, but the purpose of a great military scientific school is wider than this. Savages fight with bludgeons; civilized men with their wits. A civilized country should, therefore, keep its wits so ordered as to be able rapidly to use them to the greatest advantage, and so long as it is necessary for our country to maintain a military establishment as a protection against the sudden and unavoidable emergency of war, the counsels of prudence and forethought bid us take such steps as will enable us to afford surprises to our enemy, rather than to lag inquiringly and defensively behind the surprises which he prepares for us. Nothing is more striking in the present war than its development and applications of science. The submarine and airplane are the most spectacular scientific novelties, but there are many others. Instruments of extreme delicacy, applying old principles in new ways, and familiar devices put to unfamiliar uses all count for success in military operations.

It may well be that such a scientific or engineer school as I am here suggesting should be conceived as a part of the plan for a wider reorganization of the system of military education, but in the midst of war and the instant activities which it entails it would not be seasonable to ask attention to the details of such a system, nor can we see clearly what those details ought to be in view of the fact that this experience has caused a widespread interest in military training as an adjunct to the ordinary curriculum of colleges and scientific and technical schools, and it may therefore well be that when we have advanced out of the present struggle the essential associations of science in supreme national emergencies will so far have been realized as to make of civilian academic and scientific educational enterprises the natural laboratories for military study, leaving only the highly specialized research and coordination of invention and discovery to be performed in a distinctively national and higher military school.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, 29 West 39th St., New York; Jan. 16 and 17, 1918, New York; Charles Warren Hunt, secretary.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS, 35 Nassau St., New York; Jan. 14, New York; F. A. Molitor, secretary.

NEW ENGLAND WATER-WORKS ASSOCIATION; 715 Tremont Temple, Boston; Jan. 9, Boston; Willard Kent, secretary.

AMERICAN WOOD PRESERVERS' ASSOCIATION; Baltimore, Md.; Jan. 22-24, Chicago; F. I. Angier, Baltimore & Ohio R.R., Mount Royal Station, Baltimore, Md., secretary.

CANADIAN SOCIETY OF CIVIL ENGINEERS; Montreal; Jan. 8, Montreal; Fraser S. Keith, 176 Mansfield St., Montreal, Can., secretary.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS; Dec. 27-29, Chicago; C. K. Shedd, Ames, Ia., secretary.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; Feb. 7-9, Chicago; H. B. Alvord, secretary.

At the meeting this evening of the **Canadian Society of Civil Engineers**, Montreal, the speaker will be Phelps Johnson, past president of the Society and president of the St. Lawrence Bridge Co. His subject will be "Quebec Bridge, Some Views of the Shop Work." This will be the third of a series of illustrated lectures on the bridge, and will deal with the more important phases of the shop work and the fabrication of the superstructure.

At the regular bi-monthly meeting of **The San Francisco Association of Members of the American Society of Civil Engineers**, held Dec. 18, there was a new feature, consisting of several short talks by members of the association on the subject, "Why Engineers Have Not Achieved a Higher Rank Among Professions."

The Boston Society of Civil Engineers met on Dec. 19 and listened to an address by Charles T. Main, who was recently elected to the presidency of the American Society of Mechanical Engineers, on "The Foundations of the New Technology Buildings." On Dec. 18 the society, with the Society of Printers, was entertained by the Massachusetts Institute of Technology.

The Northwest Society of Highway Engineers, membership of which is composed of engineers of Oregon, Washington and Idaho, met in Salem, Ore., Dec. 15. O. Laurgaard, city engineer of Portland, is president of the society.

After the regular meeting of **The Engineers' Society of Milwaukee**, which is the Milwaukee section of all national engineering societies, on Dec. 12, there was a talk by Henry Freeman on forgings, and a talk by R. S. MacPherran on the structure of ingots, billets, forgings, etc., illustrated by micrographs projected on the screen. The society also paid a visit during the evening to the Allis-Chalmers forging plant.

The Yakima Engineers' Club was formed Nov. 24 by the engineers of the Yakima Valley, Washington. R. K. Tiffany, project manager, U. S. Reclamation Service, was elected president. J. O. Greenway, drainage engineer, Yakima County, vice president, and J. E. Forman, formerly city engineer of Yakima, Wash., secretary-treasurer. N. H. Gilman, present city engineer, D. R. Redman, designing engineer, U. S. Indian Irrigation Service, and C. E. Crownover, construction engineer, U. S. Reclamation Service, are the directors. The club was formed for the purpose of promoting social relations among the engineers of the valley and exercising a beneficial influence on public affairs. Membership includes civil, mining, electrical and mechanical engineers.

The Illinois Association of Members of the American Society of Civil Engineers, with 10 present at the annual meeting, Dec. 10, elected the following officers for the ensuing year: President, A. S. Baldwin; vice president, C. L. Strobel and A. F. Reichmann; secretary-treasurer, Edgar S. Nethercut. On account of the favorable condition of the treasury, dues for 1917 were ordered remitted. The organization still holds to its original single purpose, that of obtaining representation of Illinois members in the administration of the society. The executive committee reported informally against anything beyond this political activity.

At a combined meeting of the **Engineers' Club** and the **Cincinnati Section, American Society of Mechanical Engineers**, this evening, the annual meeting and election of officers of the club will be held, and there will be an address by the president of the club, Prof. A. M. Wilson.

The regular annual meeting of the **Florida Engineering Society** will take place Jan. 7, at Jacksonville, in the assembly room of the Seminole Hotel. The chairman of the local committee on arrangements is C. S. Hammatt, 20 Ocean St., Jacksonville.

The Detroit Engineering Society held a meeting on Dec. 13, in the conference room of the Detroit Board of Commerce, at which R. E. Conder, of the Boston Woven Hose and Rubber Co., delivered a lecture, illustrated with motion pictures, on "The Story of Rubber—What It Is and What It Does." On Dec. 21 W. R. Mott, of the National Carbon Co., Cleveland, Ohio, will address the society on "The Flaming Carbon Arc," and on Jan. 5 the speaker will be H. M. Brinckerhoff, engineer with Barclay, Parsons & Klapp. His subject will be "The Detroit Traffic Situation."

The Engineers' Club of Dayton, Ohio, held its regular monthly meeting Dec. 4, the program of the evening being a discussion of the principal features of the Liberty motor for airplanes. Maj. J. G. Vincent, of the Aircraft Engineering Department, Signal Corps, U. S. Army, who took a prominent part in the design of the motor, was the principal speaker. Capt. H. B. Marmon, of that department, and C. F. Kettering, of Dayton, participated in the discussion. Major Vincent and Captain Marmon have established permanent headquarters in Dayton.

The Engineers' Society of Western Pennsylvania, at its regular monthly meeting, Dec. 18, listened to an address on the "Design and Progress of the Floating Frame Reduction Gear," by John H. McAlpine, member of the Institute of Naval Architects, Pittsburgh, Pennsylvania.

The Associated Engineering Societies of St. Louis held a joint meeting, Dec. 12, under the auspices of the American Society of Civil Engineers, at which W. J. Knight, consulting engineer, spoke on "The Design and Construction of the Bevo Plant."

PERSONAL NOTES

FRED G. WHALEY, former city engineer and water superintendent of Chehalis, Wash., who resigned recently, has accepted a position with the State of Washington as valuation engineer, working in coöperation with the state examiner's department on water and light utilities. His work will cover the whole State of Washington.

H. GORDON HINKLE, Altoona, Penn., county engineer, has been appointed city manager by the city commissioners-elect. Mr. Hinkle was born in Germantown, Philadelphia, in 1874. For years he was division manager of the Union Traction Co., Philadelphia.

W. R. ELLIOTT, chief engineer for the Salt River Valley Water Users' Association, has been appointed project manager by the board of governors of that association, which took over the Salt River Valley Irrigation Project from the United States Reclamation Service on Nov. 1. Mr. Elliott was formerly employed as supervising engineer by the Reclamation Service. He was appointed engineer for the Water Users' Association in 1913, and is the first project manager to be appointed by the water users themselves on any project in the United States.

MAJ. WALTER E. WINN, Engineer Officers' Reserve Corps, who has been on duty with the 114th Engineers at Camp Beauregard, Louisiana, has been promoted to be lieutenant colonel of Engineers, R. C., and assigned to the 114th Engineers. Colonel Winn is a native of Alabama, an alumnus of the University of Virginia and a graduate of the Ft. Leavenworth engineers' training camp of August, 1917. He has

spent the greater portion of the past 15 years in the Mississippi Valley in the practice of engineering.

A. E. HANSEN and W. S. COULTER, New York City, have terminated their partnership, except for the conclusion of certain engineering works. Mr. Hansen will continue in the practice of hydraulic and sanitary engineering at the office heretofore occupied by Hansen & Coulter, at 2 Rector Street.

G. R. HAWES, formerly designer on pulp and paper-mill work for the Colonial Lumber and Paper Mills, Ltd., B. C., under V. D. Simons, industrial engineer, Vancouver, B. C., is now in private practice at Tacoma, Washington.

MAURY NICHOLSON has resigned as assistant city engineer of Birmingham, Ala., after serving in the city's engineering department for the past 17 years. Mr. Nicholson will be connected after Jan. 1 with the Chickasaw Shipbuilding Co., Mobile, Ala., where he will have charge of the laying out of two towns.

LEONARD S. CAIRNS, assistant general manager of the Manila Electric Railroad and Light Co., Manila, P. I., has been appointed general manager of the Eastern Pennsylvania Railways Co., Pottsville, Penn., by the J. G. White Management Corporation, New York City, the operating managers of both companies. Mr. Cairns succeeds L. H. PALMER, who recently became assistant to the president of the United Railways and Electric Co., Baltimore, Maryland.

BURNSIDE & BENNETT, Grove City, Penn., have disposed of their practice and equipment to FRANK P. GRAHAM, of Detroit, who will continue the business at Grove City. The change is due to the fact that Lewis E. Burnside has been commissioned first lieutenant of engineers in the National Army, and Neal A. Bennett will be called into service in the near future.

F. RINGER, chief engineer, Missouri, Kansas & Texas lines, formerly at Parsons, Kan., is now at Dallas, Texas.

WILLIAM W. BURDEN, formerly city engineer in the Board of Public Utilities, Department of Streets and Sewers, St. Louis, has been commissioned captain in the 12th Engineers (Railway Regiment) and is regimental adjutant.

LEWIS H. DELANY has left the employ of Frank L. Wilcox, consulting engineer, St. Louis, and has accepted a position with the J. G. White Engineering Corporation, in the construction of a nitrate plant on the Tennessee River at Muscle Shoals, Alabama.

W. A. KELLY, with the United States Department of Agriculture as drainage engineer for irrigated lands since 1910, and since 1913 in charge of drainage investigations in Washington, northern Idaho and Wyoming, has accepted a position with the Federal Land Bank, of Omaha, Neb., as engineer appraiser, with headquarters at Omaha.

H. G. COUTTS, formerly superintendent for Thompson-Starrett Co., on the hotel which the company is erecting in Cleveland, is now connected with the construction division of the United States Signal Corps, and is at Langley Field, Virginia.

R. F. MACDOWELL, principal assistant engineer for R. Winthrop Pratt, consulting engineer, Cleveland, Ohio, has finished his work at Camp Sherman, Chillicothe, Ohio, where he represented Mr. Pratt during the past six months on the construction of the National Army cantonment, and has returned to the Cleveland office. He will in the future give two days each week for Mr. Pratt at Camp Sherman, in an advisory capacity, on the operation of the camp utilities.

E. T. COLTON has left the city engineering department of Kansas City, Mo., where he had charge of the field work of the structural division, to become connected with the construction of the emergency wooden fleet. He is stationed at Morgan City, La., for the Union Bridge and Construction Company.

HERMAN F. DOELEMAN, consulting engineer, Baltimore, Md., has closed his office and with his employees has joined the Quartermaster Engineers' Department.

CARL P. HOFF, who resigned as city engineer of St. Joseph, Mo., has accepted a position as assistant to H. M. Stone, resident engineer at St. Joseph of the Grand Island Railroad.

FRANK P. LARMON, until recently chief engineer for the Consolidated Water Co., Utica, N. Y., is now resident engineer for the Cienfuegos, Palmira & Cruces Electric Railway and Power Co., Cienfuegos, Cuba.

J. J. GAILLARD, for many years city engineer of Macon, Ga., but who failed of reëlection recently, has become division engineer for the Portland Cement Association, with headquarters in Macon.

HALE JUDSON, formerly an assistant city engineer of St. Joseph, Mo., has become city engineer, succeeding CARL P. HOFF, resigned. RICHARD E. WACHTER, who has been first assistant city engineer, has left the city service, his office having been abolished.

ROYAL A. MEEKER, of Plainfield, N. J., has resigned as highway engineer of the State of New Jersey. WILLIAM G. THOMPSON, who was associated with Major-General George W. Goethals in the building of the Panama Canal, has been named by the latter to succeed Mr. Meeker. Mr. Thompson was assistant state highway engineer of New Jersey since last April.

F. M. SIEFER, formerly of Portland, Ore., has been appointed division engineer of the Sacramento, Calif., division of the Southern Pacific company, succeeding W. H. KIRKBRIDE.

ELBERT M. CHANDLER, Burbank, Wash., consulting engineer for the Noches Selah Irrigation District, was elected President of the Washington Irrigation Institute at its fifth annual meeting in Yakima, Wash., Dec. 4-5. E. S. Benson, commissioner of agriculture of the State of Washington, who has been president during all the previous sessions, declined reëlection because of the pressure of public affairs, but will continue as an active worker in the position of vice-president.

J. A. BIRON, who was engaged in construction work for the Casper Ranger Construction Co., at Pittsfield, Mass., is now at Holyoke, Massachusetts.

L. DREW GODDARD, Detroit, Mich., is now a captain in the Engineer Officers' Reserve Corps.

PAUL N. COATES, St. Paul, Minn., is now a sergeant in the 23rd Engineers, at Camp Meade, Maryland.

EBERHARDT MUELLER, who was with the Concrete Steel Engineering Co., Massena, N. Y., is now at Camp Hill, Pennsylvania.

G. R. BASCOM, professor of sanitary engineering in the University of Wisconsin extension division, has been called to Chicago by the national food administration to study the problem of turning waste into pork by feeding garbage to hogs. He has been working for some time on a plan to carry out the project in Wisconsin cities.

JOHN F. RICHARDSON has been made project manager of the United States Reclamation Service Truckee-Carson Project, Fallon, Nev., vice JOHN T. WHISTLER, made consulting engineer, with offices in Berkeley, California.

COLEMAN MERIWETHER, inventor of the Meriwether system of reinforced-concrete pipe for sewers and pressure lines, and president of the Lock Joint Pipe Co. for the past 13 years, has terminated his connection with that company, and has been appointed manager of the Cement Products Bureau of the Portland Cement Association, with office in Chicago.

W. H. HARTEL, with the Pennsylvania lines west of Pittsburgh, formerly at Logansport, Ind., is now at Pittsburgh.

L. W. ARMSTRONG has completed his work as supervising engineer for the War Department at Camp Kearny, Calif., and has returned to his duties as assistant engineer, City of Los Angeles, California.

S. FRANK BUTLER, district engineer of the Portland Cement Asso-

ciation at New York, has resigned to become district contract manager of the Turner Construction Co., of New York. He will be in charge of the New England district, with headquarters in Boston. Mr. Butler was graduated from Swarthmore College in 1908 and was in general construction work before going to the Portland Cement Association four years ago. He was district engineer in New York for a year and a half.

N. H. CHOATE, recently engaged on the construction of a power house and ice plant and two machine shops for the Schoellkopf A. & C. Co., at Forks, N. Y., constructed by the John W. Cowper Co., Buffalo, is now engaged on work being done for the New York Central R.R. at Gardenville, N. Y., by the same company.

S. D. WILLIAMS, JR., special engineer with the Michigan Central Railroad Co., until recently at St. Thomas, Ont., is now at Detroit.

THOMAS R. KING has left the University of Nevada, at Reno, and is now first lieutenant in the Engineer Officers' Reserve Corps, as assistant to department engineer, Western States.

R. A. HOLLENBECK, assistant engineer with the Union Pacific System, who was until recently in San Francisco, is now at Portland, Oregon.

WILLIAM P. PUTNAM has resigned as president of the Detroit Engineering Society, having taken up work in the inspection section, Gun Division, Ordnance Department, U. S. Army. The executive committee of the society nominated L. R. HOFFMAN, first vice president, to serve as president during the remainder of the year; C. W. HUBBELL, second vice president, to be first vice president; R. C. FOWLER, member of the executive committee at large, to be second vice president; and H. S. MORSE, chairman of the civics committee, to be member of the executive committee at large.

JOHN S. BATES, of Selma, Calif., has been appointed city engineer to succeed WILLIAM H. SHAFER, resigned.

HOWARD CHESTNUT has been selected for the post of city engineer of Bloomington, Ind., and will take office on Jan. 1. He was formerly connected with Schmidt & Seaman, Indianapolis.

OBITUARY

THOMAS MOONEY, for 47 years a designing engineer in the John Roach Shipyards, New York, died Dec. 11 at his home at Douglaston, L. I., in his 70th year. He was president of the Acorn Engineering Company.

GEORGE WASHINGTON DYE, formerly general roadmaster and consulting engineer for the Chicago, Rock Island & Pacific Railroad Co., died at his home in Eugene, Ore., Dec. 2, aged 81. He was prominent in the early history of the Rock Island lines and built the Oskaloosa branch of that system.

JOSEPH MORGAN, JR., chief draftsman of the Phoenix Iron Co., Phoenixville, Penn., and chief engineer of the Edgemoor Iron Co., died at his home in Johnstown, Penn., Dec. 9. He was a native of Philadelphia, but had lived in Johnstown since 1879. As consulting engineer of the Cambria Steel Co. and as a member of several mechanical and mining societies and the United States Naval Institute, he was widely known. Mr. Morgan served in the United States Navy in the Civil War, under Admiral Farragut.

BUSINESS NEWS

B. F. Affleck, Chicago, was reëlected president of the Portland Cement Association at its annual meeting in New York, Dec. 12. Mr. Affleck is president of the Universal Portland Cement Co. F. W. Kelley, president of the Helderberg Cement Co., Albany, N. Y., was elected first vice president, and Richard Hardy, president of the Dixie Portland Cement Co., Chattanooga, second vice president. G. S. Brown, president of the Alpha Portland Cement Co., Easton, Penn., was elected treasurer.

N. B. Payne has opened an office in the Havemeyer Building, 25 Church St., New York, as an electric crane specialist. He was formerly associated with Manning, Maxwell & Moore, Inc., New York.

D. S. Hays, manager of the Philadelphia office of the Haynes Stellite Co., has been commissioned captain in the Engineer Officers' Reserve Corps.

The paint and wood finishing business of the Bridgeport Wood Finishing Co., Still River, Conn., has been purchased by E. I. du Pont de Nemours & Co. The Bridgeport Wood Finishing Co. was incorporated in 1876.

G. A. Schneider, formerly of the San Francisco sales organization of the Western Electric Co., has been appointed manager of the Buffalo branch, succeeding J. W. Tabb, who has been transferred to New York.

J. C. Bannister has been made a vice president of the Walworth Manufacturing Co., Boston, Mass., manufacturer of iron pipe fittings, valves, Stillson wrenches, etc. Mr. Bannister has been connected with the manufacture of this type of product for 26 years, starting as foreman at the tapping department of Haxtun Steam Heater Co., Kewanee, Ill., in 1891. His headquarters will be at Kewanee, Illinois.

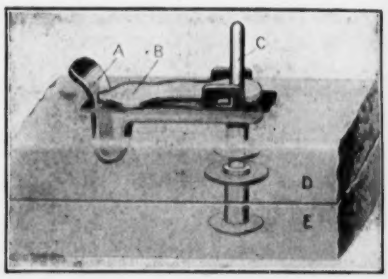
TRADE PUBLICATIONS

Peavey-Byrnes Lumber Co. has issued a 24-page, 3¾ x 6¼-in. "Handbook for Engineers' Use." It refers to longleaf pine structural timbers and gives specifications, results of tests, properties of beams and columns based on actual sizes.

APPLIANCES AND MATERIALS

Holder for Blueprints, Charts, Etc.

The Presto holder, manufactured by the National Company, engineers and manufacturers, Boston, Mass., affords a means of temporarily binding blueprints, records, charts, drawings, newspapers, etc., for ready reference. The distinguishing feature of the device is the quick-acting and positive lock shown in the illustration. Pressing *A* locks the binder, and pressing on *B* releases it. The stud *C* is securely fast-



QUICK ACTING AND POSITIVE LOCK

ened into the lower strip of the oak binder *E*, and all the locking device is self-contained in the upper half of oak-wood binder strip *D*. The holder is intended for use in engineering and architectural offices, drawing rooms, machine shops, on construction jobs, in ship yards, libraries, etc., and is designed to prevent the loss, tearing, soiling and mislaying of prints and papers.

Civil Service Examination, New York

Inspector, Board of Water-Supply—Salary $120 and $130 per month. Candidates must be between the ages of 21 and 50 and have had at least three years' experience as inspector or engineer. They must be familiar with materials of construction, with contracts and specifications and with the methods and appliances for prosecuting public works. Subjects and weights: Experience, 4; technical, 6. Applications received at Room 1400, Municipal Building, Manhattan, until Dec. 21, 4 p.m.

For further particulars see *City Record* or apply to the Municipal Civil Service Commission.